ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXVI., No 15.

TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK.....225, 240
The Park Row Building, 30 Stories High, in New York City (with inset, illustrated)..... 226
The Present Status of the Distribution and Transmission of Electric Energy.....229, 235
Garbage Utilization at Cincinnati and New Orleans (illustrated)..... 236
The Interstate Commerce Commission's Statistics of the Railways of the United States for the Year Ending June 30, 1896..... 238
A New Water Meter (illustrated)..... 240
EDITORIAL NOTES..... 232
Increase in Exports of American Manufactures—The Separation of Ashes and Garbage—Steel Frame Buildings as Consumers of Iron and Steel—The Stability of Steel Frame Buildings.
EDITORIAL.
The Cheapest Electric Lighting Plant in the World (illustrated)..... 232
LETTERS TO THE EDITOR..... 235
Railway Construction in Japan—The Conversion of Silver into Gold—Nicaragua Canal and Earthwork Slopes in the Tropics.

THE CHICAGO MAIN DRAINAGE CANAL is discussed as follows by President Eckhart in his annual report: Of the work of excavation, 90% is now completed; but the recent pollution of the lake water by sewage demands that immediate steps be taken to secure the full benefit of the sanitary district in the near future. This means the diversion of sewage from the lake, by the united action of the city authorities and the trustees of the sanitary district. Nearly nine-tenths of the present sewage outflow is already discharged into the Chicago River and its branches; and the construction of intercepting sewers by the city will bring the remaining sewage to this channel. The completion of the main channel and the admission of water from the lake, says Mr. Eckhart, will remove the present source of pollution from the lake and restore sanitary conditions in Chicago. The engineering department reports upon the main drainage canal, as follows:

Total amount of contracts	$19,261,619.62
Total amount earned	17,119,942.38
Total amount to be earned	$2,141,677.24
Total reserved percentage and unpaid vouchers	2,231,652.32
Total required to complete existing contracts	$4,373,329.56
Amount earned, 89.03 per cent.	

A special committee of the trustees has been appointed to confer with the city authorities concerning the speedy utilization of the drainage canal.

THE WATER POWER AND ELECTRIC TRANSMISsion plant at Fresno, Cal., described in our issue of July 2, is of special interest on account of the great head of the water and the distance which the power is transmitted. The water is carried to the reservoir by 7 miles of canal and flume, and from the reservoir extends the pipe line, 4,020 ft. long, with a total head of 1,400 ft. The pipe is of steel, coated with asphalt, and is laid partly with the Converse screw sleeve joints and partly with flange joints. The cast-iron flanges are shrunk on and beaded to the pipe, reinforced by ⅝-in. rivets through flange and pipe between each bolt hole. One flange is recessed and the other has a corresponding annular projection, a 3-16-in. rubber gasket being placed between the faces. The flanges are drawn together by 16 bolts 1 in. diameter, 10¼ ins. long. The pipe was supplied by Dunham, Kerrigan & Hayden, of San Francisco, and the pipe line was made up as follows:

980 ft. of 24-in, riveted No. 12 steel.
880 ft. of 24-in. riveted ¼-in. steel.
400 ft. of 20-in. lap-welded 5-16-in. steel (Converse joints).
800 ft. of 20-in. lap-welded 5-16-in. steel (cast-iron flange joints).
1,000 ft. of 20-in. lap-welded ⅜-in. steel (cast-iron flange joints).

The 5-16-in. pipe was tested to 600 lbs. pressure, and the ⅜-in. pipe to 1,000 lbs. pressure. Air inlet valves of ample area are provided to prevent a repetition of the collapse due to a sudden emptying of the pipe. The pipe ends in a jet driving the Pelton water wheels. The current is carried over a transmission line wire for a distance of 35 miles, and 75% of its power is delivered at the switchboard.

BIDS FOR THE REMOVAL AND DISPOSAL OF THE garbage of Brooklyn were received Oct. 5 from five different parties, as given in detail in our Construction News Supplement. The lowest bid was from the Brooklyn Sanitary Co., which proposes to use the Arnold system of utilization, now employed to treat a large part of the garbage of Philadelphia and soon to be put in use for the treatment of all the garbage of New York. This company made two offers, one for a plant located within the city and another for a plant on Barren Island, where the plant for New York is now being built. The next lowest bid was from E. J. McKeever & Co., for the Brownlee system of garbage cremation. The three offers named were as follows:

Year.	Brooklyn Sanitary Co., for plant. In City.	On Barren Island.	E. J. McKeever & Bro.
First	$90,000	$113,000	$144,000
Second	91,000	117,000	144,000
Third	92,000	120,000	144,000
Fourth	93,000	125,000	144,000
Fifth	94,000	130,000	144,000

WATER POLLUTION FROM SEWAGE has been worse in Chicago this year than ever before, according to reports from the Health Commissioner of that city, and corresponding with this pollution the death rate from zymotic diseases has increased so much as to presage a repetition of the typhoid fever epidemic of 1890-92. For the first nine months of 1896, the number of fatalities from typhoid fever has been 559, an increase of 71% over that for the same period of 1895, and nearly the rate per 10,000 population attained in 1889, just preceding the epidemic noted. The deaths from typhoid thus far in 1896 are 3.17% of the total deaths from all causes. In 1889 the corresponding figures were 2.67%. As noted in the last issue of Engineering News, these conditions have aroused the city officials to exert themselves to find some remedy, and at a recent meeting the special committee on water supply of the city council authorized the mayor to appoint a commission of three engineers to suggest plans for a complete system of intercepting sewers designed to receive the sewage now flowing directly into Lake Michigan and turn it into the Chicago River, whence the drainage canal can receive it. At present, 29 sewers, taking the sewage of some 400,000 people, discharge directly into the lake, 17 on the north side of the Chicago River and the remainder on the south side. Fully 90% of the sewage of the city now enters the lake through the Chicago River, and all this will be diverted through the drainage canal when that channel is completed. The only thing that will prevent the canal taking all the sewage is the flow of the 29 sewers mentioned above directly into the lake, and this the intercepting sewers, if built, will remedy. About 90% of the work on the drainage canal from Bridgeport to Lockport, 28 miles, is now completed, and an official statement from the trustees of the sanitary district asserts that the remaining work necessary to furnish the flow of 300,000 cu. ft. per minute will be finished in 1897 or early in 1898.

ELECTRICITY ON THE MANHATTAN ELEVATED in New York city was given a practical trial, Oct. 5, the experiment being made on the 34th St. branch, between the Long Island Ferry and 3d Ave. A third rail laid on the outside of and 10 ins. higher than the regular rails carries the current. Contact is made by means of two sliding steel shoes. The motor car carries, when fully equipped, a storage battery of 256 cells which may be used in case of blockade or failure of current in the third rail, and which serves to keep the load on the line and on the station fairly uniform. The battery alone, it is said, will operate a train for 19 miles at a speed of 35 miles per hour. The motor car is 18 ft. long and slopes from a height of 8 ft. in the center to 3 ft. at the ends. The electric current is also used to light the cars, which is a new departure on the New York elevated lines. The locomotive has two General Electric motors of 125 HP., and weighs 10 tons.

CAR PAINTING BY COMPRESSED AIR is being tried on the Pittsburg & Lake Erie R. R. The yard is well supplied with air pipes, and the barrel of specially prepared paint is mounted on a hand truck so that it can be moved to any part of the yard. The air line consists of 100 ft. of 1-in. heavy hose; the paint suction hose of 50 ft. of ½-in. heavy hose. The barrel is equipped with a float of pine wood with 4-in. hole in the center. Over the hole is a small hose-bearing tower, used as a support and hose regulator, insuring a uniform feed of paint. This device is light in weight, and can be readily carried to top of a box car for spraying the roof. The time for carefully spraying a box car is 30 minutes. To employ a man to follow with a long-handled 8-in. whitewash brush, 30 minutes additional, making labor cost one hour per box car, each coat. To coat a coal car of 60,000 lbs. capacity takes 20 minutes for each coat, including the time of two men. This road is also using a device for spraying on paint for the lettering, which, for covering uniformly, is considered a decided improvement over the stencil brushes, and will lead to a great saving in the wear and tear of stencil plates.

A FOLDING CAR STEP, set below the bottom fixed step, is being tried on some cars of the Gulf, Colorado & Santa Fe Ry. Its purpose is to facilitate entrance to and exit from the car, and it is expected to be more convenient than the stools or boxes carried by the car porters. A lower fixed step cannot be used, as it would be liable to be struck by platforms, etc. This folding step was designed by Mr. F. W. Farrell, Master Car Builder, at Galveston, Tex.

THE ELECTRIC MOTOR CARS for the Brooklyn Bridge cable railway are now being delivered. They are 45-ft. cars, weighing 28 tons, or 36 tons with the four 100-HP. electric motors and equipment, and closely resemble the present cars. There will be one motor car to each train and it will be used to switch the train from the incoming to the outgoing track, thus dispensing with the present shuttle movement of the steam locomotive which pushes the trains out from the station to the point where the cable is picked up. The motor car will also haul the train at night, when the cable plant is shut down for inspection. A shoe on each motor truck will take the current from a rail conductor laid outside of the track rails. The cars were built by the Pullman Palace Car Co., of Pullman, Ill., and the electrical equipment was fitted by the General Electric Co., at Schenectady, N. Y.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision of freight trains, Oct. 1, at Philson, Pa., on the Baltimore & Ohio R. R. An eastbound train descending the steep grade of the Allegheny mountains got beyond control and could not be stopped at the siding where it should have waited for the westbound train. The train went down the grade at high speed and struck the westbound train, which had two engines. The three engines and 34 cars were wrecked. The bodies of 18 men, all tramps, were found in the wreck, and several of the trainmen were injured. The accident occurred on a grade of about 2.3%, 17 miles long, from Sand Patch tunnel to Hyndman. It is said that 16 cars (or about half the train) had air brakes, and that the brakes were tested satisfactorily at Sand Patch, but that the tramps (large numbers of whom ride on these trains) meddled with the brakes, cutting them out of service.——A double collision of freight trains occurred Sept 30 at Niagara Junction, N. Y., on the Lehigh Valley R. R. A freight train had stopped to cool a hot box and was run into by a following double-header freight train, derailing one engine and the caboose, and throwing them across the other track in front of a westbound freight train. The two engines went down the bank and a number of cars were wrecked, four or five of the cars being destroyed by fire. One man was killed and another fatally injured. It is said that a signal which should have been set to protect the rear of the standing train, was not set at danger until the second train was seen approaching.

A TUGBOAT BOILER exploded Sept. 29 in the East River, New York, near Hell Gate. The tug was the "Robert Lockhart," of the Lehigh Valley R. R., and was towing three heavy coal barges against the tide. The boat caught fire and very nearly drifted on the rocks, but was hauled out of danger by the "Edna B. King."

A BOILER EXPLODED at No. 2 Colliery, Harwood, Pa., on Sept. 28, killing one man and seriously wounding two others.

THE BURSTING OF THE DAM of the lake at the Fair Grounds, Staunton, Va., Sept. 30, caused a flood in Lewis Creek which caused considerable damage to property and the loss of several lives. The accident was due to the high water in the lake, caused by heavy rains.

THE HEAVY GALE AND STORM of Sept. 29 caused widespread damage along the south Atlantic coast. The town of Cedar Keys, Fla., was almost entirely wrecked, and great destitution will result, while a number of persons were killed and injured. A number of the boats of the sponge fishing fleet were lost, with all hands. At Savannah, Ga., the loss by damage to buildings, etc., will probably amount to $1,000,000. Several ships were blown ashore on the coast and in the rivers, plantations were flooded, electric light and power plants shut down. Extensive damage was also done at Baltimore and Washington.

TWO RIVALS FOR THE STEAM ENGINE in its usual form are now receiving much attention, the steam turbine and the gas engine. Which one is eventually to displace the reciprocating steam engine for the direct driving of dynamos is a matter of doubt, but the Westinghouse Machine Co., which builds the well-known Westinghouse steam engine, is preparing itself for either event by embarking in the manufacture of both steam turbines and gas engines. It has recently placed both upon the market. The turbine is of the Parsons type, which has for some years been on the market in England. The gas engine is a new design, the result of some years of experiment by Mr. George Westinghouse. It is a two-cylinder engine, using the Otto cycle, but with a governor which controls the admission of both air and gas in such a way that an explosion occurs at every stroke. The result is a very good regulation, such that dynamos driven directly on the shaft of the engine furnish an entirely satisfactory light, free from flickering. Two of the gas engines are now running in the Pittsburg Exposition.

THE LARGEST INSTALLATION OF WATER TUBE boilers on any steam vessel is that of the Belleville boilers on the new British battle-ship "Powerful." A detailed description of the plant is given in Engineering News of Sept. 25. There are 48 boilers in all, designed to work at 200 lbs. per sq. in., which pressure is reduced to 210 lbs. by Belleville valves. The total heating surface is 69,453 sq. ft., equal to 2.77 sq. ft. per designed horse-power (22,500 I. HP.), and the total fire-grate area is 2,192 sq. ft.

THE PARK ROW BUILDING, 30 STORIES HIGH; NEW YORK CITY.

(With Inset.)

The rage for phenomenally high office-buildings still continues unchecked in New York city, and there seems to be at present some rivalry here as to who shall build the highest structure. The design and construction of these very lofty buildings calls for some very interesting engineering work.

The first part of the work of designing such a building is the preparation of general elevations and floor plans, by the architect, but the structural or constructional design is largely an engineering rather than an architectural work, since with the steel skeleton style of construction necessary for these great buildings, the exterior masonry and treatment which are visible in the finished work are merely the clothing and ornament of the steel framework. Nevertheless the general plan and appearance of the structure are the first considerations, and it is, therefore, the architect who is first engaged to prepare the plans, and who may either prepare the structural design for himself or entrust the work to an engineer, subject, of course, to his approval as being responsible for the entire work. In all buildings of this character the architectural design and arrangement considerably complicates the arrangement and detailing of the structural ironwork.

The highest building thus far designed in New York city is the Park Row Building, which is to occupy the site of the old International Hotel on Park Row, opposite the Post Office, and work is already in progress on the foundations. This will be an office building, with stores on the street floor, and a restaurant at the top. The main part of the building will have 26 stories, while at the two front corners will be four-story towers, the total height from the curb to the tops of the cupolas being 386 ft. Below the curb level will be a basement and a cellar. The St. Paul Building, close by, has 25 stories, and is 313 ft. high from the curb (Eng. News, May 7, 1896); while the American Tract Society Building has 20 stories in the main part, three more in the tower, and is 291 ft. high to the top of the roof of the tower (Eng. News, Dec. 27, 1894).

The general appearance of the new building is shown in Fig. 1, which is reproduced from one of the water-color drawings prepared in the architect's office.

The plan of the building is very irregular, as shown in Figs. 3, 12 and 13, owing to the impossibility of securing some of the property at any reasonable price (until the owners of this property found that the new building could be built without it, when their demands at once fell considerably but it was then too late). The building will have a frontage of 103 ft. 11 ins. on Park Row, 20 ft. on Ann St., and 47 ft. 10½ ins. on Theater Alley, while the depth from Park Row to the alley will be 153 ft. 7¾ ins. The area covered will be 15,000 sq. ft., and this is entirely on a deep sand foundation. The foundation will be carried on piles driven into the sand to a depth of about 20 ft., this system having been satisfactorily employed for the American Tract Society Building, where no settlement has occurred. There will be about 3,500 foundation piles of good sound American spruce, free from knots and ring strokes, and having the bark left on. They are 10 to 14 ins. diameter at the head, perfectly straight and 20 to 25 ft. long; and have the heads cut off below the level of ground water, or at 34 ft. 4 ins. below the level of the curb on Park Row. For the Tract Society Building (which was also built by Mr. Robertson) it was specified that the piles should be driven to a greater depth than 20 ft., but it was found difficult to get them down more than 20 ft. without breaking or brooming them, while where they were very close together the piles would sometimes refuse to go more than 10 ft. into the closely compacted sand. For this reason a depth of 20 ft. or to a hard bearing has been specified for the piles for the Park Row building. The piles will be driven about 16 to 18 ins. c. to c., beginning at the center of each pier or group, and working outward, while the rows of piles will be about 24 ins. c. to c. No pile is to be loaded with more than 16 tons, and the allowed pressures are 15 tons per sq. ft. on brickwork, and 40 tons per sq. ft. on granite. The site of the building will be excavated to a depth of 34 ft. below the curb line. An additional 12 to 16 ins. in depth will be excavated between and around the heads of the piles for a clear space of 12 ins. from the piles, and this space will be filled in with a concrete composed of 1 part Portland cement, 2 parts sand and 5 parts broken stone not over 2½ ins. in size. This concrete will be tamped to a hard consistent mass, and leveled off flush with the heads of the piles. The Portland cement used is specified to be of the Stettin or Ooland brands, all of which must be of recent manufacture, and no retempering of the cement will be allowed. The sand must be coarse, sharp and clean. Upon the concrete capping will be laid large granite blocks for bases for the piers, which will be of brick, with granite capstones to carry the grillage beams. The bottoms of these grillage beams are to be 29 ft. 1½ ins. below the finished level of the first floor on Park Row.

FIG. 1. GENERAL VIEW OF THE PARK ROW BUILDING; NEW YORK CITY.
Architect. R. H. Robertson.
Consulting Engineer, Nathaniel Roberts, M. Am. Soc. C. E.

It will be seen from the foundation plan, Fig. 3, that most of the columns rest on distributing girders, which in turn rest on a grillage of I-beams on two or more of the masonry foundation piers, while some of the interior columns rest directly upon grillages upon isolated piers. Each foundation had to be especially designed for the column loads to be sustained by it, the size of girders and the size and weight of grillage beams varying according to location. The long girder on the Theater Alley front is carried by 61 I-beams, 12 ins. deep, 32 lbs. per ft., 4 ft. long. The girder for columns G7, G8, has 13 15-in. I-beams, 67 lbs., 8 ft. 8 ins. long, and 11 15-in. I-beams, 41 lbs., 3 ft. 4 ins. long. The girders for columns A2, B2, etc., have 20 15-in. beams, 67 lbs., 8 ft. 8 ins. long, and 4 15-in. I-beams, 41 lbs., 3 ft. 6 ins. long. The grillages for isolated column foundations have a lower row of 15-in. I-beams, 45 lbs., and an upper row of 24-in. I-beams of 68 or 80 lbs. per ft. The grillage beams are I-beams of length, depth and number suitable to each individual foundation, and these are laid upon the granite caps of the brick piers, being set in a bed of cement, ½-in. thick, on top of the caps, any difference of thickness of over ½-in. being made up with layers and cross layers of flat steel bars, grouted in cement. Each span of grillage beams up to 5 ft. in length has four cast-iron separators, while where the beams are over 5 ft. long, six separators are used. The separators are box-shaped, with milled surfaces to bear evenly and truly on the top and bottom flanges of the beams.

The distributing girders are of plate construction, having two to four webs, their length ranging from 8 ft. to 47 ft., and their depths from 44 to 96 ins. The typical construction is shown in Fig. 5, and the details of one of the heavy girders are given in Fig. 11, which shows the girder at the Theater Alley front. The weight of this is about 105,380 lbs. for a length of 47 ft. 2½ ins. In all cases the web stiffeners are required to have a bearing at top and bottom. Fig. 14 shows the location of some of the girders in relation to the columns. The make-up of some of these distributing girders is given below:

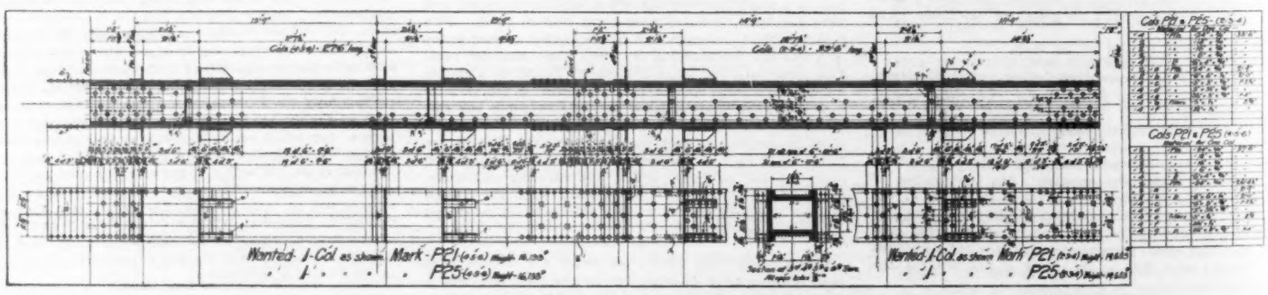


FIG. 10.—DETAILS OF MAKE-UP AND CONNECTIONS OF COLUMN P 21.

Girders A1, B1, and F1, G1; 4-web plates $\frac{7}{8} \times 96$ ins., 8 angles $\frac{7}{8} \times 6 \times 6$ ins., 6 plates $\frac{3}{4} \times 32$ ins.

Girders A2, B2; F2, G2, and A6, B6 are similar but with 6 plates $\frac{7}{8} \times 32$ ins.

Girder A9, D10; 4 plates, $\frac{3}{4} \times 72$ ins., 8 angles $\frac{3}{4} \times 6 \times 6$ ins., 10 plates 13-16 $\times$ 32 ins.

Girder F3, G3; 2-web plates $\frac{1}{2} \times 96$ ins., 1-web plate $\frac{7}{8} \times 96$ ins., 8 angles $\frac{3}{4} \times 6 \times 6$ ins., 2 plates $\frac{5}{8} \times 32$ ins.

Girder F''; 4-web plates $\frac{3}{4} \times 44$ ins., 2 cover plates $\frac{1}{2} \times 32$ ins., 8 angles $\frac{3}{4} \times 6 \times 4$ ins.

All columns which do not rest on distributing girders, but have isolated foundations, are supported on short girders on a set of I-beams resting on the grillage beams, so as to distribute the weight evenly over the caps of the piers. The general arrangement of the foundation construction is shown in Figs. 2, 3, 4, and 5. The cellar floor will be level with the base of the granite cap, so that the steel girders will be accessible for inspection and repainting.

There are practically no two columns of identical section in the entire building, the irregular arrangement preventing any uniform loading, so that each column has had to be designed and built up for the particular load. The loads range as high as 2,900,000 lbs. All the columns are of box section (Figs. 7, 8, 9, 10), some being square and others of rectangular section, while in one case a double-box section is used, Fig. 8. They are flanged at every story, near the floor beams, to support the surrounding masonry. The bed plates are planed to a smooth surface to avoid shimming, and all the columns in the walls are to be carried up 3 ft. above the roof beams, and there connected with a line of 8-in. channels under the balustrade coping. The weight of columns P22 and P26 is about 58,080 lbs. per section of length.

The floor beams are generally composed of two I-beams, with cast-iron separators 5 ft. apart, these separators being the full height of the beams and bolted with $\frac{3}{4}$-in. bolts. There are three or four separators to each span, so made that the flanges of the beams will be not less than $1\frac{1}{2}$ ins. apart. All floor beam tie-rods are to be $\frac{3}{4}$-in. diameter, set 3 ins. above the bottoms of the beams. The floor beams of each tier are framed so that the bottom will present two different levels, one 5 ins. above the other. In the area where 15-in. beams are used, the beams and girders will be framed flush (or coped together). Where 10 and 12-in. beams are used they are framed flush and level at the bottom, which is to be 5 ins. above the bottom of section where 15-in. beams are used. The plan of the framing of the first floor, Fig. 12, is reproduced direct from one of the drawings, and shows the general character of the drawings as sent out from the office of the consulting engineer, the illustration being about one-third the size of the original. It will be seen that the irregular plan of the building results in a somewhat complicated arrangement of the floor framing. The horizontal diagonal members are for wind bracing, while the semicircular arrangement at the back is for a group of elevators.

Box and lattice girders connect the columns at the walls. The lattice girders in the light courts are 48 ins. deep over chords, and those in the solid side walls are 36 ins. deep. Those in the light courts have the bottom set 1 in. lower than the 15-in. floor beams, and all have their chord angles $\frac{3}{4}$-in. apart to allow of the easy connection or attachment of cast-iron lintels and sills. The outer ends of the light courts are spanned at every other floor by plate girders having curved bottom chords. The elevation of the ironwork of the north wall is shown in Fig. 6.

The main roof over the 25th story will be formed flat, like a floor, and will be sufficiently strong to carry a water tank of 10,000 gallons capacity. The roof over the 27th story (in the middle of the front) will be formed by angle-iron trusses 6 ft. apart, with T-iron purlins $12\frac{1}{2}$ ins. c. to c., to carry safely a load of 100 lbs. per sq. ft. The walls and roof of this portion will be of vertical I-beams, with terra cotta block filling. The roofs of the turrets and lanterns will be of tees and angles, and the turrets will have a metal roof covering. Over the Ann St. front will be a dome, square in plan.

The amount of steel work in the building will aggregate about 9,000 tons. All beams, connections,

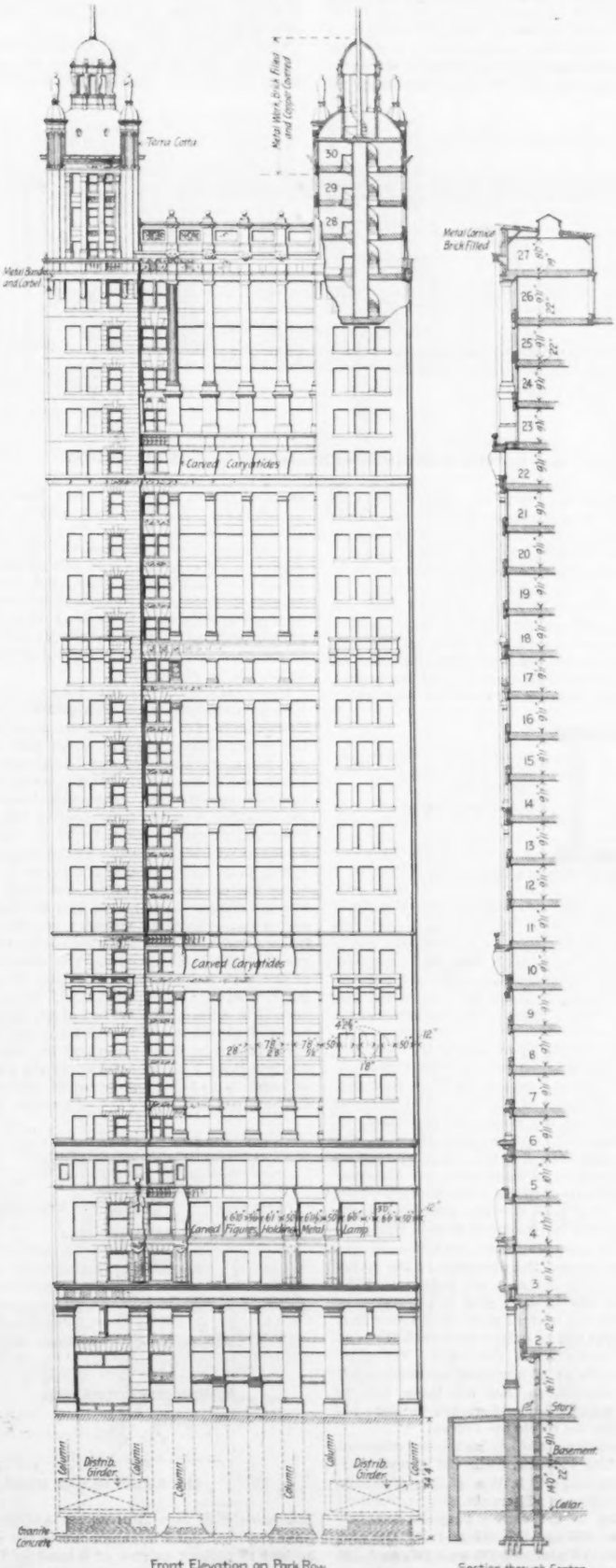


FIG. 2.—GENERAL ELEVATION AND PART CROSS SECTION.

rods, girders, angles, tees and channels; all built-up sections, and all cantilevers and columns, are to be of medium steel having an ultimate strength of not less than 60,000 lbs., nor more than 68,000 lbs. per sq. in.; elastic limit, half the ultimate strength; minimum elongation, 20% in 8 ins.; minimum reduction of area at fracture, 40%. The metal must bend cold 180° to a diameter equal to the thickness of the test piece, without a crack or flaw on the outside of the bent portion. The smoke flue and all its connections and appurtenances will be of mild steel. No variation of more than 2½% in weight or cross-sectional area will be allowed.

The specifications provide that all abutting surfaces of compression members, such as columns, shoes, etc., must be planed to even bearings, and all finished surfaces must be protected by white lead and tallow. All surfaces that will be inaccessible after assembling, must be cleaned and well painted (before assembling) with three coats of best red lead paint and oil, or asphaltic or graphite paint. The entire structural work of cast iron, wrought iron, and steel must be cleaned, dried and painted with two coats of paint (as above), and three coats on all portions which will be surrounded by masonry.

Rivets will be usually ¾-in. and ⅞-in. diameter, the pitch not exceeding 6 ins., nor 16 times the thickness of the thinnest outside plate, nor less than three times the diameter of the rivet. The distance between the edge of the piece and the center of rivet holes must not be less than 1¼ ins., except for bars less than 2½ ins. wide, and when practicable it must be at least twice the diameter of the rivet. The rivet heads must be concentric, with a height of at least 0.6 the diameter of the shank. Rivets will be machine driven wherever practicable. In punching, the diameter of the punch must not exceed the diameter of the rivets by more than 1-16-in., and all holes must be clean cut. The use of drift pins is allowed only to bring together the several parts of one member, and the pins must not be driven with such force as to disturb the metal about the holes. The rivet holes for splice plates of abutting members must be accurately spaced, so that the holes will be truly opposite when the members are brought together and before the rivets are driven.

The wind bracing consists of horizontal diagonal bracing in the floor systems, while the column connections with the box and lattice girders also give great lateral stiffness. There is also a vertical diagonal bracing in the panels between the following columns: G5 and G6, G7 and G9, G8 and G10, A3 and B3, A6 and B6, D6 and D7, and D8 and D9. This is composed of two angles 9-16 × 4 × 6 ins. in the lower stories, and the sizes get smaller in the upper part of the building. There will be a temporary erection bracing, as shown by dotted lines on the iron work elevation, Fig. 6, which consists of 1½-in. rods, with eye ends, pins and turnbuckles.

There will be two steel tanks of 10,000 gallons capacity, one in the cellar and one on the roof. Each will be 14 ft. diameter and 9 ft. high, of 5-16-in. steel plates, with a ½ × 4-in. band around the upper edge. The roof tank will be blocked up 15 ins. above the beams. The steel smokestack will be made in sections, one story high, riveted together, with expansion and contraction joints at every third and fourth story, each section being supported directly on the floor beams of its section. This smokestack will be of steel plate ⅜-in. thick for 100 ft., then 5-16-in. for 100 ft., and then ¼-in. to the top. All sills, mullions and lintels for windows will be of cast iron.

The treatment of the exterior can be credited to no established style of architecture, but may be classed as that of the "American skyscraper" style, the great height, narrow width and necessarily flat front or facade of such buildings rendering necessary a special treatment which it is difficult to make effective. The general appearance of the building, and the treatment of the Park Row front are shown in Figs. 1 and 2. The exterior masonry will be of granite to the top of the third story, then buff Indiana limestone to the sixth story sill on the Park Row and Ann St. fronts, and the remainder will be of buff brick, terra cotta and stone. The brick masonry backing will be of Haverstraw hard-burned brick, laid in cement, and grouted with liquid cement. The exposed portions of the side walls, court walls, and Theatre Alley front, will be faced with IXL brick, specially burned to a hard, impervious, glossy surface. The walls of the light courts will be 16 ins. thick, and the columns in those walls will be fireproof, with not less than 8 ins. of brickwork, the inner course of which is to be of hollow brick. Other columns will have not less than 4 ins. of common brickwork.

Bluestone caps 24 × 20 × 12 ins. are used for the floor girders. All brickwork below the street will be laid in cement mortar of 3 sand to 1 Portland cement, and the coping will be set and pointed in Portland cement mortar and sand 1 to 1. There is to be a water-proof or damp-proof course laid through the vault walls, and all other walls in contact with earth, being carried up 2 ft. above the surrounding earth or to the level of the curb. This course consists of three continuous layers of hot asphalt or plastic slate and three layers of paper impervious to moisture. The concrete of the roof will be covered with five alternate layers of hot asphalt or plastic slate and four layers of moisture-proof paper, finished off with ¾-in. roofing tiles, gutter and leaders, laid in Portland cement and pointed. The kitchen and serving rooms will have rock asphalt floors. The sidewalk will be of 2½-in. bullseye lights, set in cement in cast-iron frames, with a stone curb 24 ins. wide.

The floors will probably be of terra cotta flat arches of end construction, the blocks being 12 ins. deep for the 15-in. floor beams, and 10 ins. for the others. The blocks will be set in Portland cement mortar, and covered with cinder concrete. The weight of this block construction and top filling must not exceed 65 lbs. per sq. ft. where 15-in. beams are used, or 45 lbs. where 10-in. beams are used. The partitions will be of terra cotta blocks, 3 ins. thick for the basement and all floors except the first floor, which will have 6-in. blocks. Porous terra cotta bands will be fitted, to which to nail the base, chair rail, picture molding, plaster grounds and trim. It is possible that the Roebling system of flooring and partitions will be used, if authorized by the Building Department. In this case there will be a steel ribbed wire cloth and concrete arch, at least 3 ins. thick at the crown, with suspended ceilings of No. 20 stiffened wire netting, leaving 1 in. air space below the bottoms of the beams. The floors would be guaranteed to carry 500 lbs. per sq. ft., uniformly distributed. The Roebling partitions would be 2 ins. thick between finished plaster surfaces. The smokestack will be enclosed by double partitions, with a 4-in. air space between them. The rough concrete over floor arches and for the tile flooring will be cinder concrete, composed of 8 parts clean, dry cinders (no ashes), 2 sand and 1 Portland cement. This will be filled in to within 1½ ins. of the finished floor surface or 3 ins. above the tops of the beams. A similar concrete, 3½ ins. thick, will be used for the flat roof. The roof filling of the towers will be 4-in. porous terra cotta blocks, laid in Portland cement. The entire building will be plastered with

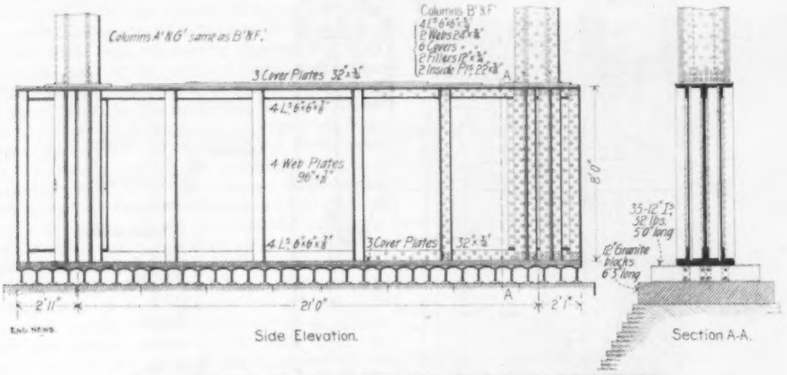


FIG. 5.—TYPICAL DETAIL OF GRILLAGE AND DISTRIBUTING GIRDER.

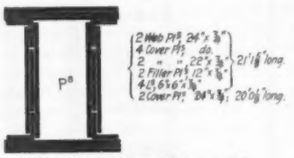


Fig. 7.—Section of Column P 8.

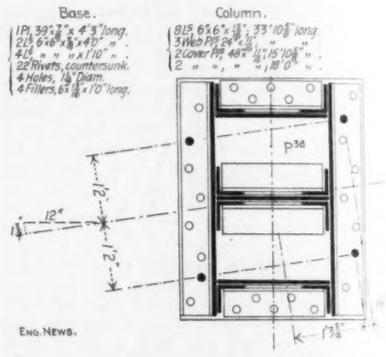


Fig. 8.—Section of Double Box Column, P 38.

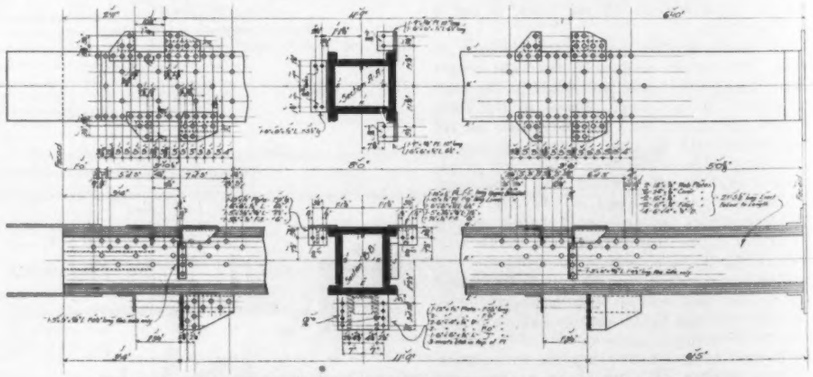


FIG. 9.—DETAILS OF MAKE-UP AND CONNECTIONS OF COLUMNS P 22 AND P 26.

a quick-drying material, such as rock or adamant plaster.

In the construction of the foundations, all adjoining walls will be shored up and strongly underpinned with brick work laid in Portland cement, this underpinning being 4 ins. thicker than the wall it supports. The underpinning will be carried down to a depth of 34 ft. 6 ins. below the Park Row curb, and will have a foundation of concrete 12 ins. thick and 12 ins. wider than the wall. Granite columns may be used by the contractor for the underpinning. Sheet piling and bracing may be used to protect the adjoining walls, while the shoring and underpinning are being done, and the braces are not to be removed until the work is thoroughly finished and set.

During the execution of the foundation work the side of the street will be sustained by sheet piling and shoring. Sidewalk bridges are built for pedestrian traffic, these being 6 ft. wide and specified to carry safely a load of 300 lbs. per ft. of the whole area, while the platforms for depositing the construction material must be strong enough to safely carry 500 lbs. per sq. ft. Along the bridges are 7 ft. fences of ¾-in. dressed and matched spruce boards.

The elevator plant for such a building is a very important detail,as it is necessary to carry passengers swiftly, yet easily. The plant will be tested by loading each car with 3,000 lbs. live load, and giving each car 200 full trips up and down within ten hours, running on a uniform schedule. One elevator will be for carrying freight and safes, and will have the front and sides removable, while the platform must be designed to carry a safe weighing 8,000 lbs. The power plant for the elevators will include three Worthington pumps (one triple-expansion and two compound), and a special duplex pump for the freight elevator when lifting safes. Separate elevators will extend from the top main floor up into the towers, as shown in Fig. 2. The elevator equipment is given in detail in the accompanying table.

The architect of the building is Mr. R. H. Robertson, of New York city, and Mr. A. Pauli is in charge of the building and its erection for him. The constructional steel work was all designed and worked out in detail by Mr. Nathaniel Roberts, M. Am. Soc. C. E., Consulting Engineer, of New York city and Jersey City, N. J., who also has charge of working out all the detail drawings of the steel framework of the structure. Mr. Geo. Shea Dayton, Chief Draftsman for Mr. Roberts, has had a large share in the responsibility for this work. The general contract was let to Mr. John Downey. The contract for the excavation and foundation work has been let to Mr. T. P. Galligan; that for the steel and iron work to J. B. & J. M. Cornell, and that for the masonry to Dawson & Archer. The building is being erected for the Park Row Construction Co., and its cost will probably be in the neighborhood of $2,000,000. We are indebted to the architect and the consulting engineer for plans and information made use of in the preparation of this article.

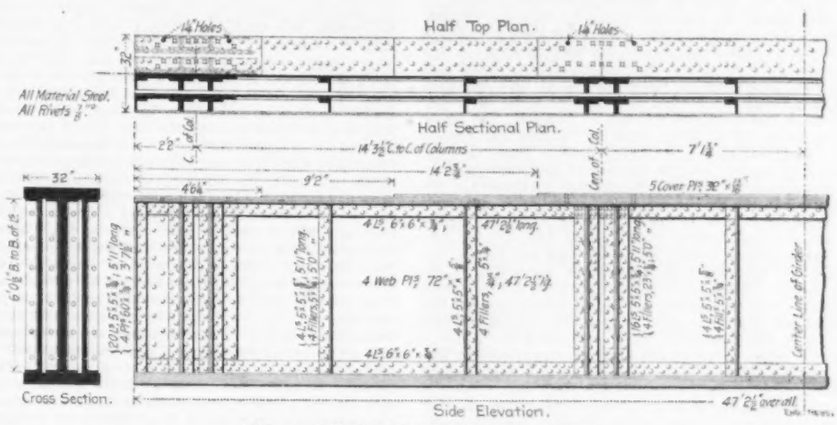


FIG. 11.—DETAILS OF DISTRIBUTING GIRDER.

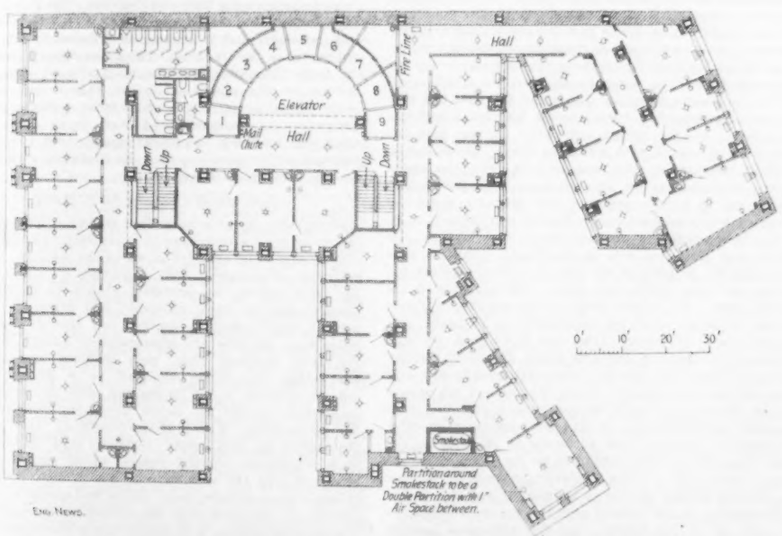


FIG 13.—PLAN OF THIRD FLOOR, SHOWING ARRANGEMENT OF OFFICES.

Elevator Equipment for the Park Row Building, 30 Stories High.

No. of car.	Size of car.	Rise (floors).	Height of rise, ft.	Height of rise, ins.	Average load, lbs.	Safe lifting load, lbs.	Speed, feet pr. min.	Purpose.
Main elevators.								
1	6 ft. 9 ins. × 6 ft. 6 ins.	Cell. to 26	336	4	3,000	8,000	700	Pass. and freight.
2, 8	6 " 0 " × 6 " 0 "	1 " 26	308	9	3,000	.....	700	Passenger.
9	6 " 9 " × 6 " 6 "	1 " 26	308	9	3,000	.....	700	Passenger.
3, 4, 5, 6, 7	6 " 0 " × 6 " 9 "	1 " 25	297	0	3,000	.....	700	Passenger.
Sidewalk elevators.								
10	4 " 6 " × 7 " 0 "	Cellar to sidewalk.	27	1	2,500	8,000	50	Freight and safes
11	4 " 6 " × 7 " 0 "		26	6	2,500	.....	50	Freight.
Elevators to 29th story.								
12	4 ft. diameter.		26 " 29		33	3	1,200	.....	300	Passenger.
13	4 " "		26 " 29		33	3	1,200	.....	300	Passenger.
Dumb waiters.								
14	2½ " "		26 " 29		36	3	250	.....	200	Restaurant serv.
15	2½ " "		26 " 29		33	3	250	.....	200	Restaurant serv.

THE PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTRICAL ENERGY.*

By Dr. Louis Duncan.**

It is my purpose to take up the different methods of transmission and distribution of electrical energy and to consider the limits that are actually fixed by the present status of electrical development.

Generating Plants.

A large proportion of the electrical plants in this country are steam plants. In the last ten years we have advanced from small stations using high speed dynamos for light and power distribution to large stations, using, as a rule, low speed direct connected machines. The simple engines that were used some years ago have, in many cases, been changed to compound and even triple expansion engines, and where it is possible condensers have been employed. Some of the latest plants have machinery of the highest possible efficiency, and yet if we consider the price per horse-power of the power generated, we will find that it is greater than we expect. This is partly due to the fact that for both lighting and power purposes the load on the station, is, as a rule, not uniform and the apparatus is not working under the best conditions for economy. In this country electrical energy is principally generated for electric lighting, for electric traction, and for supplying stationary motors, the stationary motors, as a rule, being supplied with current from lighting stations. If we take the load diagram of such stations in large towns, we will find that the average output is not greater than 30 to 40% of the maximum output. We have, therefore, to supply a large amount of machinery corresponding to the maximum demand on the station, while for distribution a large amount of copper is required that is only being used at its maximum capacity for a comparatively short period of the time.

In stations supplying power for traction purposes we find a variation of load, but the variation is a different kind from that found in a lighting station. In the latter the load varies at different hours in the day, but for any particular instant it is practically constant. In the former the average load for different hours during which the station is operated will be practically constant, but there will be momentary variations depending upon the size of the station and the type of traffic. Taking for instance a 2,000 HP. station in Baltimore, I find that the average load is 48% of the momentary maximum load. This difference in the kind of variation for the two types of stations necessitates employment of different apparatus to obtain the maximum economy for each type. For lighting stations, triple expansion engines may be used, while for traction work, where the variation in the load is sudden and

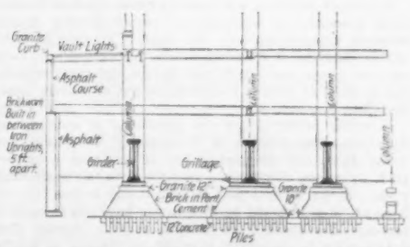


Fig. 14.—Section on Park Row, Showing Foundations and Distributing Girders.

*Condensed from the presidential address before the American Institute of Electrical Engineers, Sept. 23, 1896.

**Pres. Am. Inst. Elec. E., Johns Hopkins University, Baltimore, Md.

may occur after the steam is cut off from the high pressure cylinder, it is not well in general to go beyond compound engines, and there is even a question as to whether simple engines are not more economical when condensing water cannot be obtained. In any case, however, it is of the utmost importance as regards economy of operation that the load should be made as constant as possible.

Two distinct types of distribution are used for incandescent lighting in this country—the single-phase alternating current and the direct current three-wire system. At the present time the former does not permit the supplying of power. As alternating distribution is at high potential, it does permit the location of the station where the conditions of maximum economy can be fulfilled. The three-wire incandescent system using low voltages may be used for supplying motors, but the amount of copper necessitated by the low pressure has caused such stations to be located near the center of distribution irrespective of the best conditions for the economical operation of the plant.

With the alternating system it seems impossible to provide even a moderately steady output, but with the continuous current system the motor load during the day gives an average output greater in proportion to the maximum. Some years ago the question of the relative values of the alternating and direct current systems was discussed, and for a while most of the stations installed were of the alternating type. At present the tendency seems rather in the direction of continuous current stations, especially in towns where there is a large demand for current within a comparatively small area. There is a great advantage of direct currents in that they allow the employment of storage batteries, which equalizes the load on the station. In almost all of the large lighting plants, both here and abroad, this plan has been adopted to a greater or less extent and the results have been so favorable that the battery equipments in many of our stations are being increased. The efficiency of batteries in lighting stations is comparatively high, while the depreciation has been greatly reduced, and is not now over 5 or 6% per annum. In most systems, however, the full benefit of the storage batteries is not realized, as the batteries are placed in the station, and while the advantage of an approximately constant load is obtained, yet the further advantage offered in distribution is not secured. I will take this question up later.

In New York, Brooklyn, Boston and Chicago a large proportion of the direct current lighting stations are situated where it is expensive to handle the coal and ashes, and where the economy due to condensation is not obtained. It is also the custom to use several stations instead of a single large station, and this increases the cost of production both in operating expenses and fixed charges. The question arises whether we have reached a point where it will be more economical to consolidate the stations in the best possible location for economical production of energy, and make use of the means of distribution which have been developed in the last few years to increase the radius at which energy can be supplied.

As far as traction stations are concerned, their efficiency and output would be increased by the use of batteries, both because the machinery would be steadily loaded and because the most efficient type of apparatus could be used as is the case in lighting stations. By the consolidation of railroad properties that has taken place in the last few years, single corporations operate electric lines over extended areas. It is the custom to build a number of stations, each running a certain section of the line, the idea being that the decreased cost of copper and the decreased possibility of a shut down would more than compensate for the increased cost of operation and fixed charges. It is, again, important to consider the question whether we have not reached the point where a single station can be built in such a way that there is little or no possibility of any accident causing a suspension of the entire traffic of the system, and where improved methods of distribution will decrease the amount of copper so that it will not exceed that required by the present method of using a number of generating stations.

If storage batteries are used, the two types of variable load belonging to lighting and power stations demand different types of battery. For lighting stations a considerable capacity is required, while the momentary variations of power stations do not require any great capacity, but demand as great a maximum output as battery manufacturers can obtain.

In water power plants the conditions of economy are different. The location of the plant is, of course, definitely fixed, and the advisability of obtaining a uniform load, by means of batteries, depends upon the local conditions. If the water power is limited and is less than the demand, then it might be well to use batteries in order to increase the amount of salable power. Again, if the development is expensive, it might be cheaper to develop a smaller amount of power, pay for a smaller amount of machinery and increase the output by the addition of batteries. These are questions that can only be decided by a knowledge of the local conditions.

Electrical Distribution.

The distribution of electrical energy to consumers as distinguished from its transmission to long distances, has been largely accomplished by the agency of continuous currents although alternating currents have played an important part in incandescent lighting. As I have stated a considerable proportion of current for lighting is distributed at constant potential on the three-wire system, or at constant current on arc light circuits, while power for traction circuits is distributed at approximately constant potential at an average of say 550 volts.

I shall first consider the condition of affairs in a traction system in a large city, where a number of suburban lines are operated. If direct distribution is attempted from a single station, it will be found that when the distance exceeds five or six miles a large amount of copper must be employed to prevent both excessive loss and excessive variation of potential on the lines. On suburban lines it is the latter consideration that usually determines the amount of copper used, and this is especially true on lines where there is a considerable excursion traffic. Even in the city itself, the supplying of sections at distances three or four miles from the station may require so much copper that it would be less expensive to operate separate stations. Several methods other than the direct method may be employed to remedy these difficulties. For outlying lines where the traffic is mainly of the excursion order, being variable both during the day and for different seasons, boosters may be advantageously used. It is perhaps best from reasons of economy to run the boosting dynamos from motors. These dynamos are series wound and are connected to feeders of such resistance that the fall of potential in the wire for a given current is compensated for by the rise in voltage of the booster. There is a decreased cost of copper incidental to this system, due to the fact that the drop is not limited by considerations of regulation—the voltage at the end of the feeder being constant—while the transmission is at an increased potential. If the average station potential is 600 volts, and it is boosted 300 volts, then the copper for a given loss would be decreased in the ratio of 36 to 81. The booster system has the advantage of the direct system when the cost of the additional apparatus together with the increased loss on the line, capitalized, is less than the increased cost of the copper necessary to produce the same result by the direct system. Whether the balance is in favor of one or the other depends on the distance and the variation of the load, and it is indifferent whether the variation in the latter occurs often or not.

If any transforming device is employed to feed a distant section of the line it must be remembered that the capacity of the device must be great enough to look out for the maximum demand on this section. Suppose now that we wish to feed some suburban line where the load has considerable momentary fluctuations but where the traffic is moderately constant during the year. In this case the booster could be used with a storage battery at the end of its feeder, the battery supplying the line. The advantages of this combination are greater than with the simple booster and in many cases they will compensate for the interest and depreciation on the battery and the loss in it. If the arrangement is properly made, the load on the booster and line wire will be practically constant, thus decreasing the capacity of the booster to that required for the average load, while less copper will be required for a given loss. As to the latter point, suppose a given amount of power is to be distributed in 24 hours, say 200 amperes at 600 volts, if the load is uniform, the loss will be proportional to $200^2 \times 24$ hours. If it is all distributed in 12 hours, the loss will be proportional to $400^2 \times 12$ hours, or twice as much. So in the case of the steady load the same power could be transmitted with the same loss with half the copper. It makes no difference whether the variation extends over 12 hours in 24 or it occurs every other minute, the result will be the same. It is apparent then that it is of the utmost importance to keep the line steadily loaded, as well as the station, and this points to the location of the battery near the points of consumption and not in the station. By this system—a booster with storage batteries—it is possible, assuming the same loss, to transmit power to a distance of ten miles with approximately the same amount of copper that would be required for a five mile transmission on the direct system. It would increase the economical radius of distribution twice and the area of distribution four times. A single station could economically supply lines within distances up to ten or twelve miles. If it is desired to still further increase the radius of distribution, it is possible to do this by employing some of the alternating current methods that have come into use. I will discuss these methods later, but at this point I may remark that the use of stationary rotary transformers permits the energy to be transmitted in the form of alternating currents, and to be changed again into continuous currents of any required voltage. These rotary transformers supplied by an alternating current which is transmitted from the station at a high voltage, may be used to feed the line directly or they may be used to supply storage batteries which are connected to the line. In the latter case we have the advantage of decreased size of apparatus, of steady load on the station, and of a minimum cost of copper on the line; which system it would be best to employ would depend upon the distances and the character of the line and load.

Of the systems that I have proposed for city and suburban distribution from a single station three have been successfully employed, namely: the booster system; the booster system with batteries and rotary transformers operating directly on the line. When we consider the advantages of a single station and a steady load, it seems evident to me that many of the large traction systems would do well to concentrate their stations into one and to use the booster system with batteries for their outlying lines, and if necessary use rotary transformers for lines beyond the limit of ordinary suburban work. As to the possibility of the complete shut down of such a station, we have reached such a point in the construction of machinery, both electric and mechanical, that with a proper reserve, a careful system of duplex steam piping and with fire proof construction of the station, such a possibility may be disregarded; while the batteries would look out for any momentary interruption on the feeders.

Continuous Current Low Voltage Distribution.

Some of the most important stations supplying incandescent lamps are operated on the three-wire continuous current system. In the last few years a considerable advance has been made in the sale of power for motors from these stations, and this has increased the revenue and has given better average output. The tendency in this country has been in the direction of using storage batteries in such stations, and abroad practically every continuous current station uses batteries. As in the case of traction systems it has been the custom in large cities to build a number of separate stations instead of building a single plant and distributing from it. The batteries have been placed in the stations themselves and no attempt has been made to decrease the amount of copper used by employing a number of centres of distribution and giving the main feeders a steady load. The same considerations that apply to stations for traction work will also apply to stations used to supply lights and the same methods of distribution may be used. It would unquestionably be more economical, in many instances, to use single stations, to transmit power from these stations to centres of distribution, where batteries may be located and to distribute from these centres on a three-wire system. A case in point is the system used at Buda Pesth where the energy is distributed from the central station to rotary transformers at sub-stations, these rotary transformers feeding batteries, current being distributed from these batteries on a three-wire system. The reports of the operation of this station show that it is both economical and successful, and it might well be copied by some of the companies in this country. The gross receipts of some of the large illuminating companies bear such a large proportion to the company's stock that a comparatively small saving in operation would mean a considerable increase in the dividends, and there is no doubt in my mind that by using one power station, with battery substations for distribution, that the operating expenses can be considerably decreased.

Alternating Currents for Lighting.

Alternating currents have been employed for lighting in this country, and they have been especially valuable where a district is to be supplied in which the distances are considerable as compared with a number of customers. It has been almost the universal custom to supply small transformers for each consumer, and while the average size of transformers is greater now than it was a few years ago, yet they are comparatively small. No power has been supplied from such stations, and although alternating arc lamps are used to a limited extent, yet the number is not increasing, and in some cases continuous current arc lamps have been substituted for the alternating. Under these conditions the load on the station is even more variable than in the case of a continuous current supply where motors may be employed, and the constant loss due to the large number of small transformers used, places this system at a disadvantage as compared with the continuous current system. The great advantage it possesses lies in the increased area of distribution rendered possible by the high voltages that are used, together with the possibility of locating the stations where power can be cheaply made. Abroad in the last few years most of the new stations that have been built use continuous currents, although some years ago the greater proportion of them were alternating current stations. It is also the custom abroad to use sub-stations with large transformers for distribution, thus doing away with a considerable part of the constant loss due to the small transformers used here. It is not possible, at the present time, without greatly complicating the system, to obtain a steady load on the station, and the only question that arises is the value of sub-stations, and the possibility of using some form of alternating current other than the single-phase.

Methods of Electrical Transmission.

Coming to the question of transmission of electrical energy as distinguished from the supply to customers from distributing centers, there have been great advances made in the last few years, and these mainly through the introduction of multi-phase alternating currents. Single-phase alternating currents permit the transmission of power to long distances and its distribution for lighting purposes. It is also possible to supply power from such circuits to large motors working under a steady load. It is not possible, however, to distribute

power economically for ordinary uses. As most long distance transmission schemes contemplate the substitution of electric motors for steam engines, and as their success will, in many cases, depend upon the possibility of such substitution, single-phase alternating currents are not at present able to comply with the conditions imposed by the desired service. The introduction of multi-phase alternating systems, where two or more alternating currents are employed, the currents differing in phase, has completely changed the situation with respect to long distance transmission. I shall consider briefly the possibilities of such systems and their value as compared with any direct current system.

Continuous Current Transmission.

The first long distance transmission plant was operated by the continuous current system, and even now plants are being built in which continuous current of high potential are used to transmit energy to distances up to 15 miles. As compared with transmission by means of alternating currents, we will find that the continuous current system possesses some advantages and some disadvantages. If we consider the relative cost of the copper in the line for a given amount of power transmitted and for a given maximum potential between the conductors, we will find that the relative amounts for the continuous current and the different alternating current systems, will be as follows:

Continuous current	100
Single-phase alternating	200
Two-phase "	200
Three-phase "	150

We see then that the continuous current has a marked advantage over the alternating current systems as far as the cost of copper is concerned. There are, however, certain practical disadvantages belonging to this system. The high voltages necessary for long distance transmission makes it impossible to distribute the current at the receiving end without first reducing the voltage. With continuous current this can only be done by employing a rotary commutator of some kind. A plan which has been practically and successfully used has been to run a number of dynamos in series at the generating end of a line, while at the receiving end are a number of motors, also arranged in series, which are used to drive other generators to give the required type of current and the desired voltage. It has not been found possible to make either dynamos or motors of any great output, as there are practical difficulties in running dynamos of high potential where the current taken from them has a considerable value. M. Thury has installed a number of continuous current transmission plants that have apparently given excellent results. At Biberist, a transmission of 15 miles is employed. At Brescia, 700 HP. are transmitted over 12 miles at a maximum of 15,000 volts. M. Thury states that generators for 45 amperes can be constructed up to 3,000 volts, and he thinks that 4,000 could be successfully used. These machines, however, are small when compared with the 5,000-HP. dynamos in use at Niagara, for instance, and where the transmission is a large one the great number of machines necessary would be a serious objection to this type of transmission. It will be seen that the greatest possibility of trouble in such a transmission lies at the ends of the line, in the generating and receiving apparatus. It is necessary, no matter what our voltage is, that both the dynamos and motors shall be directly subjected to it, and this with commutated machines will always be a source of danger. If we are to do any considerable amount of lighting from such a station, our energy for this purpose undergoes three transformations before it reaches the lamps, and the efficiency would not be so high as in a corresponding alternating current system. It would hardly be possible to supply motors for ordinary work at the high voltages used for transmission, and the current for them would have to be transformed in the same manner as the current for the lamps. It must be recognized, however, that this system has been successfully used and has given excellent results in a few cases of transmission. Its great advantages lies in the decreased amount of copper as compared with the alternating systems, and in the absence of induction effects, which are a drawback to alternating current transmission.

Transmission by Alternating Currents.

A large proportion of the transmission plants that have been installed in the last few years have been of the alternating current type. These have, as a rule, given satisfactory results, and the installations that are now being erected or planned are almost exclusively on an alternating current basis. The great advantage of this system lies in the fact that it is possible to change the voltage of the current without the use of rotating apparatus, and at once economically and safely. Low voltage dynamos may be used, the voltage may be increased in any desired ratio by stationary transformers, the energy may be transmitted at an increased voltage and at the receiving end of the voltage may again be reduced by transformers. If we compare this method with the continuous current system, we will see that to obtain an alternating current of the required pressure at the receiving end of the line, we would use the same number of transformations required by the continuous current system. We have the great advantage, however, that our changes in voltage have been obtained by the agency of stationary apparatus, which is much cheaper, is more efficient and is safer than that required in the continuous current system. It is possible to increase the voltage by means of transformers to almost any value with perfect safety and with an efficiency as high as 98% or 99%. If then our alternating current, when it has been reduced at the receiving end, is as valuable for distribution as the current obtained by the direct current system, there will be no doubt that alternating transmission has great advantages over continuous currents.

I have spoken of the relative amounts of copper required by the single-phase, two-phase and three-phase alternating currents. I do not think it necessary to explain minutely the difference between these systems, as they are well understood. In a single-phase system a single alternating current is used. In a two-phase system two alternating currents, whose phases differ by 90°, are employed, while in the three-phase system, there are three currents differing in phases by 60°. I shall consider the characteristics of these three systems, as there has been much discussion especially as to the relative value of the last two of them for transmission work. I shall not discuss the various modifications of the systems, but shall confine myself to general considerations. There is no single-phase motor in successful commercial operation that does not require to be started from rest by some outside means. This prevents a single-phase current from being used at the present time for power distribution; and as, in most transmissions, the distribution of power is an important item, single-phase currents are not suitable for this purpose. In a two-phase system the currents are usually carried on separate pairs of wires, while in the three-phase system, three wires are generally used, a common return being unnecessary as the sum of the currents is zero, unless the circuits are unbalanced. In distributing on the three-phase system, a fourth wire can be employed, as it gives an advantage in the amount of copper used.

In all these alternating systems the great difficulty lies in the fact that the inductance of the circuit causes the current to lag behind the electromotive force. This decreases the amount of energy transmitted by a given current at a given voltage; it causes a drop in the voltage of the line, and it increases the armature reaction of the dynamo for a given current. The total inductance of the circuit is made up of the inductance of the transformers, of the dynamos, of the receiving apparatus and of the line. In the case of transmission to very long distances the line inductance is a large proportion of the total, while the inductance of the receiving apparatus depends upon whether lights or motors are to be supplied and upon the construction of the latter. When the different wires of the multi-phase system are fed from windings on the same dynamo armature, then the drop in voltage due to any excess of load on one of these circuits cannot be compensated for on the dynamo itself. If the amount of current and the lag of the current is the same for all of the circuits of the system, then it is easy by a compound winding of the dynamo, or by changing the current in the field winding, if there is no compounding, to keep the voltage constant at either the sending or receiving end. When the load on the different wires of the system is not the same, however, it is, as I have stated, impossible to keep all of the circuits at the proper voltage. Where a two-phase transmission with separate circuits is used, then if the separate circuits are wound on different armatures, each can be regulated to give a constant voltage at the receiving end. This is the case, for instance, in the large dynamos built by the Westinghouse Company for use at the World's Fair in Chicago. The difficulty due to the uneven loading of the circuits is specially marked in the case of the three-phase system, and it is one of the principal objections that have been urged against the employment of this system for distribution. It should be pointed out, too, that it is not enough to balance the quantities of current for the three-branches of the system, but the character of the current must also be considered. A non-inductive load on one wire, with an inductive load of equal value on the others would cause an unbalancing just as if the currents differed in amount. In most of the transmission plants that are being operated and that are proposed, it is required to run both lamps and motors from the same circuits, and while a slight variation of potential on the motors would not cause any particular trouble, yet the successful operation of the lamps requires a practically constant voltage. I think, however, and the same grounds have been taken by others, that in any practical transmission of considerable size, it is possible to so balance the loads that this difficulty will not exist to an extent to cause any serious trouble. When the distributing part of the lines is reached it is usually the custom when a three-phase transmission is used to employ four instead of three wires. As for line induction in the two-phase and three-phase systems, there is no question that the latter has an advantage in this respect. By suitable arrangement of circuits the line inductance can be brought to a minimum, and this is of the utmost importance in long distance transmission. I will not take into account the supposed increased efficiency of three-phase motors and dynamos as against two-phase apparatus, as there is a question as to whether a superiority exists, but simply considering the decreased amount of copper required and the decreased inductance of the line, there is no question, in my mind, that for transmission, the three-phase system is superior to the two-phase. It is well known, of course, that the inductance of the circuit can be, in some measure, compensated for by the use of condensers or over-excited synchronous motors. The first of these remedies is, however, a very uncertain quantity commercially, while the second should be used as much as possible, that is, as many synchronous motors should be connected as is practicable. The best remedy, as things stand at present, lies in the careful construction of the line and the apparatus, so that the effects, although they exist, can be reduced to a minimum.

It has been shown by Mr. Scott, and others, that it is possible to transform a two-phase into a three-phase current, to transmit it and to transform it back again to a two-phase current. This will allow us, if we wish, to use two-phase dynamos for generating the current, to transmit with the advantage incidental to the use of three-phases and at our reducing end to use two-phase circuits for transmission. This has some advantages as far as balancing the voltage on the circuits go, and it has been proposed in the case of several plants whose installation is being considered.

Looking broadly at the value of alternating transmission as against continuous current transmission, we have a gain in the simplicity and safety in the transmission, and at the distributing end the use of multi-phase currents enables us to supply both lamps and power with an economy and success comparable to that of the continuous current system. If it is necessary to use continuous currents for certain types of distribution at the receiving end, they can be obtained by the use of rotary transformers, by which the alternating current is transformed into a continuous current. These machines have approximately the efficiency of corresponding continuous current dynamos, while the output for a given size is about 50% greater.

Possible Voltages and Distances of Transmission.

A number of calculations have been made as to the possibility of transmitting electrical energy to very long distances. If the question of cost of transmission alone is considered, then where water powers or culm heaps are within distances of 100 miles of some large center of consumption, it has been shown that it would be profitable to generate and transmit electrical energy. In these calculations, however, voltages are assumed that have never been employed for commercial plants, and whose availability is problematic, while sufficient stress is not ap-

(Continued on Page 235.)

Plants for Long-Distance Electric Power Transmission.

Name.	Type.	Distance, miles.	Line voltage.	HP.	Remarks.
Ouray, Colo.	Direct.	4	800	1,200	Successful, increasing.
Geneva, Switzerland	"	20	6,600	400	Successful.
San Francisco, Cal.	"	12	8,000	1,000	Successful, nine years.
Brescia	"	12	15,000	700	
Pomona and San Bernardino	Single-phase Alt.	13½ to 28¾	1,000	800	Successful, increasing, 4 yrs.
Telluride, Colo.	" " "	3	3,000	400	To be increased, 3,200 HP.
Bodie, Colo.	" " "	12¼	3,400	100	Successful.
Rome, Italy	" " "	188	6,000	2,000	Increasing, 9,000 HP., 3 yrs.
Davos, Switzerland	" " "	2	3,600	600	Successful.
Schongelsung, Germany	" " "	4½	2,600	820	"
Springfield, Mass.	2-phase Alt.	6½	3,600	820	"
Quebec, Can.	" "	8	5,000	2,150	"
Anderson, S. C.	" "	8	5,500	200	"
Fitchburg, Mass.	" "	2¼	2,150	400	"
Winooski, Vt.	3-phase.	2½	2,500	150	"
Baltic, Conn.	"	5	2,500	700	"
St. Hyacinthe, Can.	"	5	2,500	600	" two years.
Concord, N. H.	"	4	2,500	5,000	" two years.
Fresno, Cal.	"	35	11,000	1,400	" to be increased.
Big Cottonwood to Salt Lake City, Utah.	"	14	10,000	1,400	"
Lowell, Mass.	"	6 to 15	5,500	480	"
Sacramento-Folsom, Cal.	"	24	10,000	4,000	One year.
Redlands, Cal.	"	7½	2,500	700	3 yrs., ext'd'g to other towns.
Lauffen to Frankfort, Germany	"	100	30,000	300	(Experimental.)
Lauffen to Heilbronn	"	9	5,000	600	Successful.
Oerlikon Works, Zurich, Switzerland	"	15¼	13,000	450	"
Portland, Ore.	"	12	6,000	5,000	"
Silverton Mine, Col.	"	4	2,500	400	" to be increased.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published every Thursday at Tribune Building, New York. Entered at the Post Office, New York, as Second Class Matter.

D. McN. STAUFFER, CHARLES WHITING BAKER.....EDITORS.
WM. KENT, E. E. R. TRATMAN, M. N. BAKER, CHAS. S. HILL, A. B. GILBERT.....ASSOCIATE EDITORS.
CHAS. W. REINHARDT.....CHIEF DRAFTSMAN.

EO. H. FROST, F. P. BURT.....BUSINESS MANAGERS.
ALFRED E. KORNFELD, New York.....
F. A. PECKHAM, Chicago.....ADVERTISING REPRESENTATIVES.

PUBLICATION OFFICE.....Tribune Building, New York.
CHICAGO OFFICE.....1636 The Monadnock.
LONDON AGENCIES: KEGAN PAUL, TRENCH, TRUEBNER & Co. (Limited), Paternoster House, Charing Cross Road; SAMPSON LOW, MARSTON & Co., (Limited), St. Dunstan's House, Fetter Lane.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5 00; 6 months, $2.50; 2 months, $1.00; Single copies, 15 cents. To all other countries in the Postal Union, add $2.08 per annum (4 cents per number) to above prices for postage. No club rates allowed. Mailing addresses may be changed at will by sending both old and new address. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay. The number on the address label of each paper indicates when subscription expires, the last figure indicating the year and the one or two preceding figures the week of that year; for instance, the number 326 means that subscription is paid to the 32d week (that is the issue of Aug 6) of the year 1896; the change of these figures is the only receipt sent, unless by special request.

In the description of the Water Power and Electric Transmission Plant of the Big Cottonwood Power Co., in our issue of Oct. 1, we neglected to state that the photographs which accompanied the article were furnished by the courtesy of the General Electric Co., through its representative, Mr. J. McGhie.

The notable increase in exports of American manufactures during the present year was discussed editorially in our issue of Aug. 13. We are now able to present figures showing how considerable and rapid has been the growth of our exports of manufactured goods during the past four years and especially during the past year:

Year.	Exports of manufactured goods from U. S. during first 8 months of year.
1890	$99,887,607
1891	113,532,976
1892	99,125,836
1893	113,618,131
1894	118,049,055
1895	129,441,726
1896	163,112,670

The "Journal of Commerce," from which we take the above table says:

It will be observed that the increase in exports of manufactures for eight months is larger this year than for any previous year in the commercial history of the country. The increase over six years ago is nearly 66%, and would soon give the United States a firm footing in manufacturing exports if it could be repeated through successive series of six years.

The details of the manufacturing exports for August last have not yet been fully compiled at the Bureau of Statistics. If they follow the record of other recent months, however, they will show that a large part of the increase is in classes of goods in which American skill and inventive genius are important factors. There has been a large increase of the export of refined mineral oil and of copper ingots, but the increase in these items does not begin to represent the total increase. The increase in the export of bicycles, electrical and scientific apparatus, stationery and other manufactures of paper, and railway cars and locomotives indicates that the United States have little to fear from foreign competition in these articles.

The success of American manufacturers in securing foreign orders during the present year is something of which the nation may well be proud. It is to be hoped that the trade which has been fairly won in open competition with the manufacturers of Europe may be held from this time forward. As we said some weeks ago, there is no reason why the greatest manufacturing nation of the world should not excel all others in its exports of manufactured goods.

The separation of ashes and other non-organic matter from household garbage is becoming a troublesome question in many of our large cities, and will soon be a subject of anxiety, if not of controversy, in smaller cities and towns. It has been forced to the front largely through the adoption of garbage utilization systems, which can only be profitably operated upon pure garbage, and hence require the separation of ashes, paper, etc., from the mass. But experience and reflection is teaching that all these non-organic matters in city wastes, if kept free from the contamination of the garbage can, are perfectly sanitary and thus are in no more need of expensive treatment by cremation than by utilization processes; nor do they need to be towed for miles out to sea, nor hauled for miles into some remote suburb of a city. The clean ashes are a valuable filling material. The rags, bottles, paper and various other materials are either of some commercial value or may be easily reduced to small bulk without offense by burning. It has been claimed by some of the manufacturers of crematories, that they prefer ashes mixed with the garbage on account of the fuel value of the unburned coal, but where a longer haul is required to cart ashes to the crematory than to low lands where they may be used for filling, the force of this claim is reduced or lost altogether, especially as the ashes must be handled twice at the works, once before and once after treatment, and still remain for final disposal.

New York city has, since Aug. 1, been compelling the separation of garbage from all other refuse, in preparation for the opening of the garbage utilization plant now under construction. If the system can be enforced in New York with its large apartment houses and crowded tenements, it certainly ought to be practicable in smaller places. True, New York has well organized health and street cleaning departments, which are absolutely essential to the success of the plan. Other communities may have the same if they will.

Going almost to the other extreme in point of size, the town of Montclair, N. J., a suburb of New York, with some 12,000 inhabitants, is trying through its board of health to enforce the separation of garbage from non-organic material. The method of garbage disposal in vogue at Montclair, is the primitive but sanitary one of burying beneath a few inches of soil. Farm land is leased for the purpose, but the lease prohibits the dumping of matters that will unfit the land for future cultivation. This provision, coupled with the fact that the haul is a long one, and the expense of trenching for and covering ashes altogether unnecessary, has led to the inauguration of an attempt to prohibit public scavengers from hauling mixed garbage. There are plenty of places where by short hauls ashes may be used for filling, but right here the Montclair board of health experienced one of the greatest difficulties in connection with its work. Ashes mixed with garbage, and sometimes garbage alone, were frequently used to fill in land intended for immediate use as building sites. In one instance, a property owner was fined $50 for allowing mixed garbage and ashes to be dumped in such a manner.

In view of the attempts of so large a city as New York and so small a town as Montclair, the controversy at New Orleans, briefly detailed at the close of an article in another column, seems puerile in some of its details. The city of New Orleans entered into a contract with a company to remove and dispose of the garbage of the city, the contract specifically stating that ashes and other refuse should not be mixed with the garbage. The citizens have failed to perform the separation, the company has refused to take mixed garbage, the city council has voted to annul the contract, and the matter is now in the courts. It is alleged in behalf of the citizens that carrying out the clause of the contract relating to separation would compel them to perform menial service for the profit of a corporation, an argument which appears to be a cross between a legal technicality and a political stump speaker's style of argument. The necessity of separation and its real advantage does not seem to be realized by the people, who appear to consider themselves imposed upon by the company and to forget that the contract is specific on the points named, and the company is only insisting upon its rights under the contract.

How important the construction of fireproof buildings has become, as a factor in the consumption of iron and steel, is well illustrated by the lofty Park Row Building, which is illustrated on our inset sheet this week. The total metal in this structure will reach in round numbers 9,000 tons. This is as much steel as would be required to lay 100 miles of track with 50-lb. rails, so that the construction of this single building furnishes as much business to steel works, blast furnaces and iron ore miners and shippers as the construction of a railway 100 miles in length.

Still more impressive is the comparison with bridge work. The famous Memphis bridge across the Mississippi River has the greatest span of any truss bridge in the world, except the Forth bridge, but its main cantilevers and the side spans with a total length of about 2,600 ft. weigh 7,000 tons, or 2,000 tons less than the steel in the Park Row Building. Comparing with another class of bridge work, an ordinary country highway bridge of 100-ft. span may have perhaps 500 lbs. of steel per lin. ft. in its trusses and floor, or 25 tons in the whole structure. It will be seen that no less than 360 such spans could be built, reaching, if placed end to end, nearly seven miles, with the steel which will be placed in the Park Row Building.

And this matter of the weight of the structure is of much interest in connection with the much-talked of question as to the stability of such very lofty structures under high wind pressures. We account it a remarkable instance of high wind pressures when an iron bridge is blown down; but the above comparison shows that for a given area of base, the weight of the metal work in even the heaviest bridges is trifling compared with the weight of metal in a modern "sky-scraper." Engineers accounted it a well-nigh inexplicable phenomenon when a few years ago a wind lifted from its piers an uncompleted span of the Louisville & Jeffersonville bridge, weighing 1,000 tons, and dropped it in the river. But this span covered a length of 550 ft. and a breadth of 32 ft., while the Park Row Building has a frontage of 156 ft. and a depth of 104 ft.

Of course the weight of the metal-work in the building is only a part of the weight of the structure. Besides the metal-work we have the weight of floors, partitions, ceilings, plastering, fireproofing, and the weight of the contents of the structure. Probably the entire weight of the building when completed and occupied is not less than three times the weight of the steel in its framework, or a total of 18,000 tons. What these figures represent in the way of mass and inertia, and resistance to any external force such as wind pressure is difficult for even an engineer to fully comprehend; but the comparison, when carefully made, between the mass of such a structure and the pressure that even the most powerful gust of wind might momentarily exert against it, gives one full confidence in the stability of the building.

THE CHEAPEST ELECTRIC LIGHTING PLANT IN THE WORLD.

It is quite a common thing to see in the displayed head lines of the daily newspapers the statement that this or that or the other thing is the largest or longest or smallest or shortest, or whatever particular quality is named, in the world. If one stops to analyze this statement, he must necessarily reach the conclusion that what is meant is merely that the writer of the description in question does not know of anything in existence that is larger or longer, or whatever the particular characteristic may be, than the thing of which he writes. For however wise he may be or however broad his experience, it is quite sure that his knowledge is not world-wide; and that whether he be an expert or amateur, there is a possibility or a probability that other things of which he has never heard may excel that of which he writes.

We are not in the habit of taking the daily newspapers for a guide, but in this instance we have concluded to copy for once their practice in this respect and to call the electric lighting plant which we are about to describe, the cheapest in the world. The reader will understand from the above explanation that we give no guarantee that there may not be other cheaper plants somewhere in existence. We simply assert that we have never heard of any such, and further that the

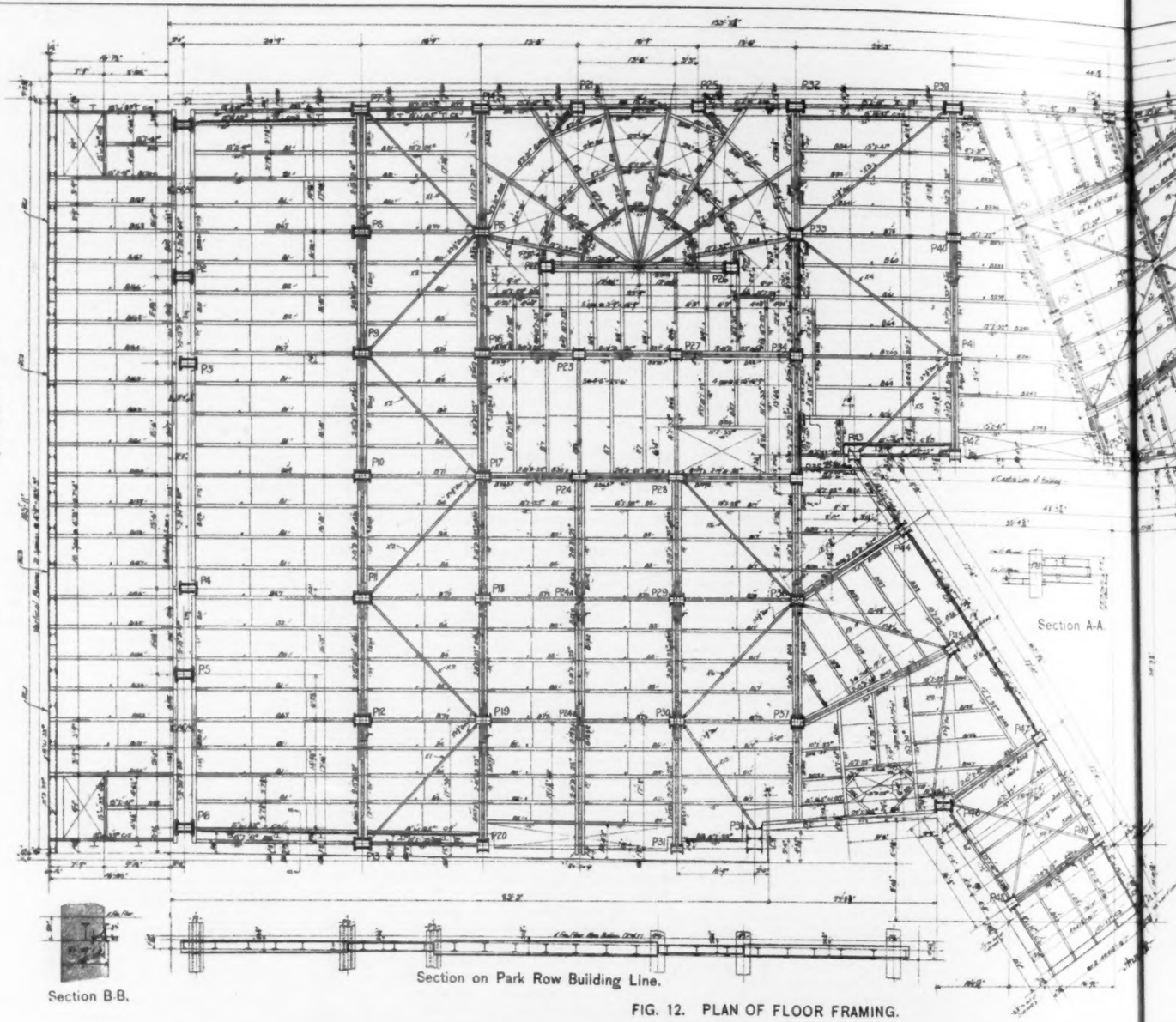


FIG. 12. PLAN OF FLOOR FRAMING.

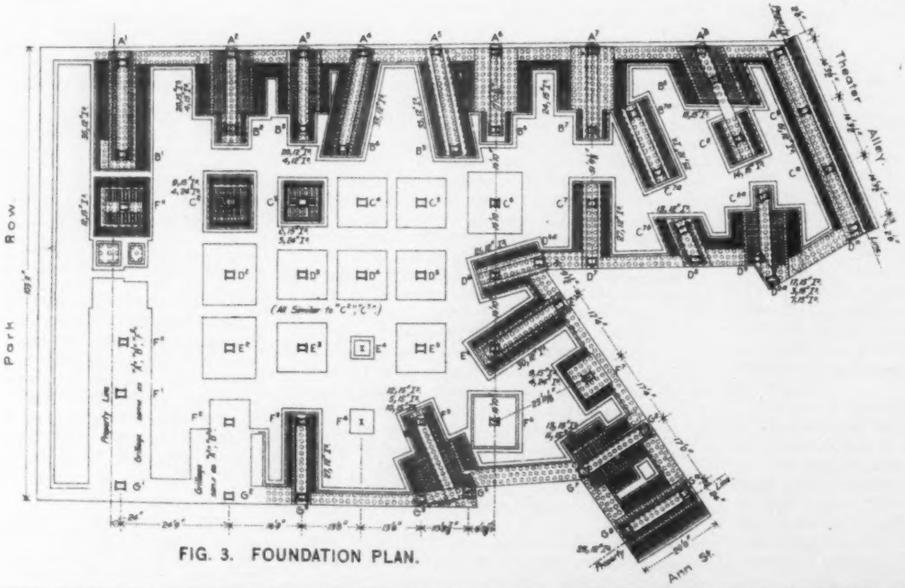


FIG. 3. FOUNDATION PLAN.

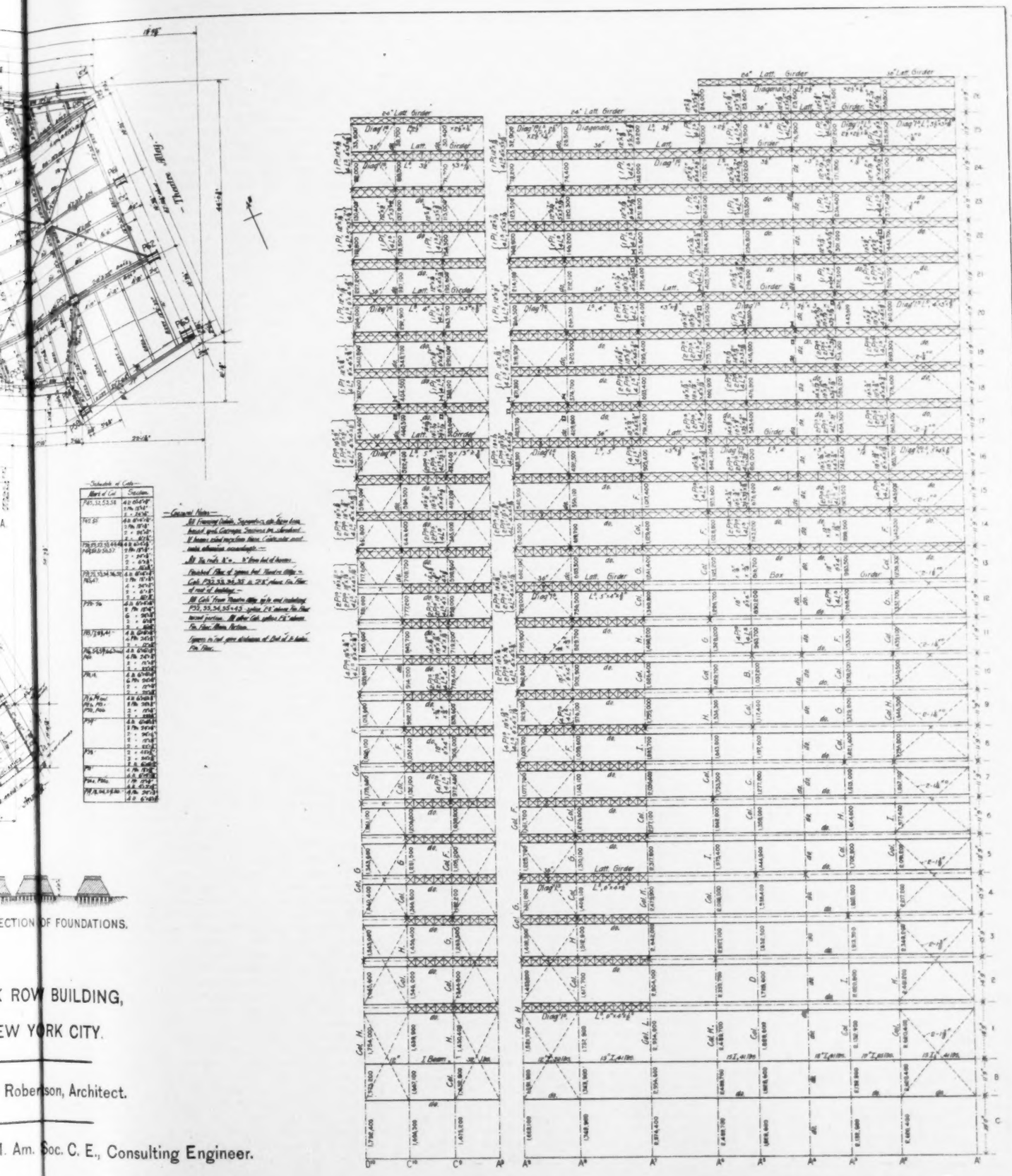
FIG. 4. TYPICAL SECTION OF FO

PARK ROW BU

NEW YORK

R. H. Robertson,

Nathaniel Roberts, M. Am. Soc.



ECTION OF FOUNDATIONS.

K ROW BUILDING,

EW YORK CITY.

Robertson, Architect.

M. Am. Soc. C. E., Consulting Engineer.

FIG. 6. ELEVATION OF STRUCTURAL IRONWORK IN NORTH WALL.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

circumstances in this case lead us to believe that electric light is being furnished by this particular plant at a cost about as small as would be possible under favorable conditions anywhere.

It is not alone because of its cheapness that this system is of interest. It is a notable instance of an enterprise carried out by a municipality with remarkable economy and success, and it is typical of what has been and may be done in hundreds of small towns to furnish them a cheap and convenient system of street and private lighting to replace the dim kerosene lamp and lessen the consumption of the world's fast diminishing store of petroleum.

The plant we are to describe is located in Johnson, Vermont, a small village in the heart of the Green Mountains, about 30 miles south of the Canadian line. The population of the village is about 600. Its assessed valuation for taxing purposes is a little short of $225,000. It contains two or three small manufactories, and the churches, school buildings, stores, etc., which one would expect to find in a New England village of its size.

View of Power House.

View of Dam and Penstock.

POWER STATION OF THE ELECTRIC LIGHT PLANT AT JOHNSON, VT.

The residents are, with few exceptions, people of very modest incomes, living plainly and simply, and a dollar goes as far in the payment of living expenses as five dollars would go in a large city.

About the only one of Nature's gifts with which this region is lavishly blessed, is water power. Within the limits of the township, mountains rise in various parts to an elevation of some 2,000 ft. above the valley in which the village lies, and the water power which runs to waste in the township aggregates probably over a thousand horse-power. Within the bounds of the village itself there has been for several years an abandoned mill-dam, which once furnished power to a large saw-mill. With the exhaustion of the timber supply the saw-mill was dismantled, and the water power was left unused.

Up to the time when the electric light plant we are about to describe was installed, kerosene was, of course, the sole illuminant. The streets were not lighted at all save as an occasional public-spirited citizen maintained a kerosene street lantern in front of his house. But stumbling along dark streets and living in dimly-lighted houses, while water power ran to waste close by, was an anomaly which at length attracted the attention of some of the more enterprising residents, and after a careful canvassing of ways and means, a village corporation was organized and the work of installing an electric light plant was begun. The abandoned mill dam and mill site above referred to was purchased for a small sum; the dam was rebuilt in a substantial manner, and on the site of the old saw-mill a small wooden building was erected for a power house. The old Humphrey turbine, which had formerly run the saw-mill was purchased with the mill site. It is a vertical 33-in. wheel, rated at 45-HP., and runs at 160 revolutions. A round wooden penstock leads to it from the dam, a distance of some 50 ft., and is hooped with round iron bands, such as are used on wood stave pipe in the West (illustrated and described in Engineering News, Jan. 5, 1893). The accompanying views show in one case the dam and penstock and in the other the power house. It will be noticed in the view of the dam that the clear water of the mountain stream as it falls over the crest in a thin veil is so perfectly transparent that in places it is not seen at all in the photograph.

The power-house machinery is very simple. A bevel gear on the vertical turbine shaft drives a gear on a jack shaft; and from a large pulley on this jack shaft a belt runs directly to the dynamo pulley on the floor above. The belt is a two-ply leather belt, and it is of interest to note that such few stoppages as have occurred since the station began running have been chiefly due to this belt.

The dynamo is a Wood alternating current machine, built by the Fort Wayne Electric Co., and rated at 750 lights, or 37 amperes at 1,000 volts. The power house has a rock foundation, and the masonry pier supporting the dynamo rests on solid rock. A small independent dynamo driven by a belt from the main dynamo shaft furnishes a 110-volt current to excite the field of the larger machine.

The switch board is of skeleton wooden construction and carries the lighting arresters, ammeter and volt meter, switches for the house lighting circuit and for the series circuit, a converter and a rheostat. It will be understood that the system in use is the one which has come into great favor within a few years for lighting small towns, in which the street lamps are connected in series and take current from the same dynamo which furnishes current to the converters for the house lighting. The street lamps are of 30 c. p. each and are placed on the same poles that carry the wires of the primary circuit. They are set at a height of 15 ft. beneath a reflector shaped like an inverted cone, with an angle of about 165°. The lamps are spaced 125 ft. apart. There are 53 of these lamps on the series circuit, and 7 other street lamps take current from the same converters that are used for house lighting.

These converters are placed on the poles of the street circuit and are small enough in size to be inconspicuous. The total extent of the primary circuits is about 1¾ miles.

Originally the system was projected solely for street lighting, but it was soon seen that to obtain light for private use was a much more important end. At present some 900 lamps are connected on the house circuits, and more are continually being added. The interior wiring was done at the outset by the contractors who erected the street circuits, and additional wiring is now done by the engineer in charge of the power plant.

Turning now to the operation of the plant, the most notable feature is the practice of running the station only during the hours when light is needed. The dynamo is started in the afternoon as soon as any lights may be needed, often before sundown on a stormy or cloudy day, and runs till 11 p. m. From the last of September until April the station is also operated from 5 a. m. until daylight. The street circuit is not turned on until the streets become so dark that the lights are actually needed. On very bright moonlight nights the street circuit is not operated.

The lighting of the streets is exceedingly satisfactory and fully exemplifies the superiority of incandescent lights over arc lights for street lighting, except in cities of such a size that brilliant street lighting can be afforded. For the average town or city of moderate size, much more satisfactory results will be obtained in street lighting if a given amount of money be expended for incandescent lights than for arc lamps. Popular ideas on this subject are often at fault. Single arc lamps at street intersections with long spaces in total darkness between, do not give as useful a light as twice the number of incandescent lamps, equally distributed. The advantage of placing the street lamps on a series circuit is that the cost of converters for these lamps, and the considerable percentage of current loss in the small converters is entirely saved.

We have been thus full in our description of the plant at Johnson in order that the figures of cost which are to follow may be understood and appreciated. The total cost of the water-power mill site, water-wheel, power-house, dynamo, and entire electric apparatus, poles, converters, street circuits, etc., complete, ready for operation, was in round numbers, $5,600, of which the principal items were as follows:

Water-power privilege, mill site, dam and turbine	$1,150
Repairs on dam, penstock and wheel tub	410
Stone foundation for power-house	84
Power-house (above foundation)	350
Pulleys, shafting, etc.	117 85
Belting	45.54
Dynamo	1,175
All other electrical machinery in power-house, and converters, poles, wires, erection, etc. (let in one contract)	1,850
House wiring (portion paid by village)	300
Consulting electrical engineer	33.10

The annual cost of operation is astonishingly small. The plant was first put in operation in January, 1895. One man is employed at a salary of $425 per annum, has the entire charge of the plant, and the hours of running are such that he not only requires no assistant, but is able to do house wiring, read meters and all other necessary work in connection with the station during the day hours. He is the only salaried employee of the corporation. The other expenses of operation are exceedingly small. The following are the principal ones, estimated as closely as possible:

Insurance (actual)	$29.25
Oil	2.00
Printing, stationery and postage	10.00
Lamps (for street lighting)	50.00

During the 20 months since the system was put in operation the repair account has been so small as to be almost nil. Two or three new steps were made for the water-wheel, and the commutator of the exciter dynamo was turned smooth, and this, with other trivial repairs, was chiefly done by the engineer of the power station, thus involving no additional cost.

The fixed charges of the plant amount to $244 per annum. The plant was paid for by the issuance of $4,000 in bonds bearing interest at 4%, and the borrowing of $1,400, which will be paid off from the surplus receipts of the corporation as they accumulate.

Turning now to the other side of the account, the revenue of the plant, the following is the schedule of rates charged for private lighting:

Stores, Offices, Etc.

For each light	$3.00
Each light in cellar or back room	2.00

Hotels.

First light in each room, except sleeping room	$3.00
Each extra light in each room, except sleeping room	2.00
First light in each sleeping room	2.00
Each extra light in each sleeping room	1.00
Each light in bath-room or water-closet	3.00
Each light in barn or livery stable	3.00

Public Halls.

Each light	$2.00
Each foot-light	1.00

Churches and Society Halls.

Each light	$1.00

Private Residences.

First light in each living-room or hall	$3.00
Each extra light in each living-room or hall	1.50
Each light in cellar	1.00
First light in each sleeping room, bath-room and pantry	1.50
Each extra light in sleeping room, bath-room and pantry	1.00
Each light in barn or shed	1.00

Meter Rates.

One-third of a cent an hour, to apply only to lighting private residences, churches, halls, hotels and manufacturing establishments. Meters to be furnished by the Village at the expense of patrons.

Minimum rate, 70 cts. per lamp per annum.

Outside Limits of Village.

Same rates as above, except that each patron is to be at the total expense of wiring, and to pay to the Corporation $1.20 for each light installed.

Regulations.

The cost of inside visible wiring will be $2.25 per light.

The Village will at any time before the contractor completes his contract wire buildings with visible wire for $1.25 per light; concealed wiring at actual expense above this, the owner to furnish lamps and fixtures in all cases. This is done as an inducement to patrons to take the light at once. All renewals to be furnished by the Village, at the expense of patrons.

Bills will be rendered semi-annually in advance, on the first days of January and July in each year, and must be settled within 30 days or the lights may be turned off without notice.

In case of deficiency of light, or any defect, notice should be given forthwith at the office that the defect may be remedied without delay.

Landlords will be held responsible for rent of lights used by their tenants.

The Village reserves the right to turn off lights in case the rents, or bills for wiring or supplies, are in arrears, or in case of violation of any rules pertaining to lights or plant. There will be an extra charge of $2 for turning on the lights again.

Rates for incandescent lights are based upon 16 c. p. lights and are to be increased or decreased proportionately as the power of lamps are increased or decreased: Providing, that not less than the price of a 16 c. p. light shall be charged for any one room, and that the price of three 10 c. p. lamps shall be the same as two 16.

All lights, meters and wiring to be subject to inspection by order of Trustees at all times.

A room which is divided by an archway will be considered as two rooms and lights in the same will be charged for accordingly.

The above rates read like a romance, it must be confessed, to users of electric light in the cities, who are accustomed to pay the time-honored rate of 1 ct. per lamp hour for electric lighting; but, as will be seen later, these rates, low as they are, are considerably above the actual cost of the light to the village corporation.

About 20 meters have been set, and in the first year of operation the total revenue from current furnished, both through meters and to lamps charged at annual rates, was in round numbers $1,000.

Besides the revenue from this source the street lighting is paid for in an indirect way. Each year the township has voted an appropriation of $200 toward the expenses of the electric lighting system. This is done on the basis that the street lights are as much of a benefit to those living outside the village, who use its streets when they drive to town, as to the dwellers in the village.

We may then sum up the results of the first year's operation of the plant as follows:

Operating expenses (about)	$525
Interest charges	244
Total outlay	$769
Receipts from private lighting	$1,000
Received from township	200
Balance of profit	$431

The increase in the number of lamps since the plant was first installed is such that for the current fiscal year the net earnings of the system will probably be between $500 and $600.

It is commonly said in criticising such figures as these that operating expenses are low because all the machinery is new and the repair account is small. It is undoubtedly the case that in making up the accounts of every such enterprise, the element of depreciation should be covered by adding a percentage of the first cost. What should this percentage be? In the present case it will be seen that on the water-power and real estate there is no depreciation. On the power-house machinery the depreciation is very small. The poles are of cedar and will probably have a life of not less than ten or a dozen years. As for the element of risk which is ordinarily to be taken into account—the chance of the machinery growing obsolete in the course of years—this is of little importance here, for the system installed is sufficiently good to satisfy the users for at least 20 years to come, no matter what advances may be made in artificial lighting. Suppose we estimate the cost of the part of the plant which is subject to depreciation at $4,000, and say that the allowance for depreciation must be such as will replace it at the end of 20 years. Then figuring compound interest at 4% we find that the annual charge for depreciation must be 3⅛% in order to effect this. This makes a charge for depreciation of $133 per annum (3⅛% of $4,000). Adding this to the operating expenses and interest charges we find the total cost of electric light per annum in Johnson village as almost exactly $900 per annum.

As we have shown above, the receipts at the start from private lighting alone were in excess of this, and with the increase in the consumption of light which is steadily going on, it is apparent that the surplus receipts will soon pay for the plant, so that it will be owned free of debt by the village. This increase of patronage, moreover, while it may necessitate the installment of some machinery of greater capacity later on, will not increase the operating expenses to any extent. The principal item in the operating expenses is the salary of the engineer; and he could operate the station alone as at present, even if it supplied twice or four times as many lights. It is not at all improbable, therefore, that a few years hence electric light may be supplied in Johnson at a considerably less actual cost per lamp even than at present.

The most common test of an electric light plant with its users is the frequency or the reverse of its breakdowns. Nor is this an unfair test on the whole; for an electric light station should be so designed and so operated that a breakdown wholly disabling the station should be made as remote a possibility as circumstances will permit. Of course in the Johnson station anything like duplication of machinery was not attempted; but in the 21 months of its operation there have only been two nights when the station was not run. In both cases the trouble was due to the wetting of the belt from a leaky pipe, which softened the cement with which the belt is made up. On one other occasion the station was shut down at 10 p. m. instead of 11 p. m. on account of the wearing down of the turbine step, causing the wheel to drop till the bevel gears slipped.

It may be of interest to inquire in what respects the plant may be criticised. Probably the most notable feature is the variation in candle-power of the lamps. The water-wheel gate is operated by hand and is opened or shut by the engineer at the station as the switchboard instruments show the increase or decrease of the load on the circuits. This intermittent regulation makes a variation in the candle-power of the lamps, which, in a city, would cause some complaints from the patrons of the station. Here, however, it appears to be accepted with equanimity, as a trifling matter and one not worth much expense to overcome. An automatic water-wheel governor of the ordinary Snow pattern is probably too slow to give much better results than hand regulation. A governor of the newer, quick moving patterns would be too expensive to be afforded.

A more important feature in which the station design will soon prove defective is the deficiency of the water-power. This has already made itself felt; and the turbine is to be replaced by a more efficient one in a short time; but this will probably give only temporary relief. Eventually it will probably be necessary to raise the dam some 10 ft. or more, which can readily be done by purchasing a little-used water-power on the same stream some 40 rods above. This would probably be sufficient for many years to come, as the village, like most country villages in Northern New England, cannot look forward to any considerable increase in size.

The Johnson electric light plant is very interesting as an example of municipal operation of a public lighting system. It will be apparent at once that if the village had waited until private enterprise furnished it with electric lights, it would have waited a very long time. The profits of the station at the very low price at which it furnishes light are too small to induce any one to undertake such an enterprise. On the other hand, if a private company had set up a station and offered current at rates materially higher than those now in force in Johnson, they would undoubtedly have had smaller net returns than those of the present station, for it must be constantly be borne in mind in the study of this case that most of those who are using the light in Johnson could not or would not afford it if its price were not so phenomenally low.

The corruption and incompetence with which municipal affairs are apt to be handled is an old story; but in the country towns of New England, where the "town-meeting" system of government still prevails, corruption or dishonesty in the management of town affairs is practically unheard of, and public matters are handled, as a rule, as intelligently and wisely as is the private business of the dwellers in the towns, which is of course all that can be expected.

The Johnson electric lighting plant was built and is managed by the trustees of the village corporation, elected annually at a village meeting and serving without compensation. The original trustees were Messrs. I. L. Pearl, O. B. Landon, C. H. Stearns, W. H. Nye and T. A. Riddle. At the last election Messrs. Enos Sherwin and B. A. Hunt succeeded Messrs. Pearl and Landon. Mr. Elmer Balch is the engineer of the power station; the writer is indebted to him and to members of the board of trustees for information used in the preparation of this article.

The reader who has carefully followed the above description will see that there are two principal reasons why electric light is furnished so cheaply at Johnson. First is the use of a water-power that costs when actually developed at the turbine shaft only about $32 per HP. The second is the construction and operation in the most simple and economical manner. The third is, we believe it is entirely fair to say, the owning and operation of the plant by the village, making it perfectly secure from competition and enabling the capital for construction to be secured at a low rate of interest, and also eliminating the element of speculation from the enterprise to a large extent.

It is because we have felt that there were some lessons in the experience with this Johnson plant which communities elsewhere might profit by, that we have given this much space to its description. There are still hundreds of country villages which, if they have not unused water-power at their doors, as had the village of which we have written, could develop water-power within a distance not so great as to make its cost prohibitory, and could thus have well-lit streets and homes in place of their present dependence on kerosene lamps.

There are other and larger communities whose water-power should be put to tenfold its present use in the distribution of electric light and power, and this will be done, when rates are lowered to a point which will encourage the extended use of electricity instead of being maintained at a point at which it is rightly regarded as a luxury.

Nor are we sure that the steam-operated electric stations have nothing to learn from the experience of the insignificant little village of which we have written. Production on a large scale is always cheaper than production on a limited scale. Other things being equal, electric light should be furnished in a city of 100,000 inhabitants more cheaply than in a village of 1,000. Is there not too great a disparity at present between the actual cost of steam power on the shaft of the engines in an electric lighting station and the cost of the same energy to the consumer when transformed to electric current and delivered at his house?

It is frequently urged that few electric lighting companies are paying good dividends, but may not this be due in many cases to the expenditures incurred for other things than legitimate and economical construction and operation?

We find manufacturing concerns installing electric lighting plants and lighting all their establishments at a trifling cost compared with other systems. We see street railway companies heating their cars by electric current although well aware that half or two-thirds as much current may be required to heat the car in cold weather as to propel it. All these things tend to show that when the business of manufacturing electrical current and transmitting it to consumers is conducted on an economical basis, it can be furnished at prices much below those now generally charged; and the large demand which will result when prices are lowered will very likely leave larger profits to owners than those that are now received.

THE CAPE COD CANAL CO., officially known as the Maritime Canal Co., has been authorized by the joint board of Railway and Harbor and Land Commissioners to issue "from time to time" the $9,000,000 stock and $6,000,000 bonds provided for in its charter.

LETTERS TO THE EDITOR.

Railway Construction in Japan.

Sir: The Sanyo Railway is the southernmost trunk line on the Hondo Island. We are just starting on the construction of 85 miles from Hiroshima to Mitashiri. After this piece is completed we have about 45 miles left from Mitashiri to Shimonoseki, which is the southern terminus of the line.

In all, Japan has now 2,350 miles of railway in operation, and the proposed lines, chartered and unchartered, amount in all to 12,000 miles. What percentage of these latter will be built, we, of course, do not know; but we conjecture that in 15 to 20 years Japan will have about 9,000 miles of railway, which would be about enough, as the geographical situation makes sea transportation very easy and economical.

While in America I thought American railway materials might be exported to Japan; but at present this seems well-nigh impossible. A few American rails have come; but at present it seems almost impossible to import them. Until a Central American canal is built the United States cannot export bulky goods to this country to any considerable extent.

Yours truly,

C. Kadono,

Assistant to Chief Engineer and Engineer of Construction, Sanyo Ry. Co.

Hiroshima, Japan, Sept. 8, 1896.

The Conversion of Silver into Gold.

Sir: My attention has been called to your issue of Aug. 17 in which you quote some remarks from the "Engineering and Mining Journal" of Sept. 5 with reference to myself. Those remarks were fully replied to by me in the next number of that periodical; but as many of your readers may not have seen my answer I trust you will permit me to make, in your columns, the following statement respecting my attitude on the question of the transmutation of metals.

I assert, and am ready to prove, if challenged to do so, that many of the most eminent men of science of to-day, as well as of past times, regard the transmutation of metals as being possible.

I assert, but am NOT ready to prove, that the conversion of silver into gold is an accomplished fact. I do not make this assertion in the hope or expectation of its being believed by anybody, whether scientific or unscientific. If Lord Kelvin or M. Berthelot or Prof. Ira Remsen were to make the like assertion, unsupported by proof, I should not feel myself called upon to believe it. I should not, indeed, doubt the personal veracity of such eminent men, but I should hold myself at liberty to deem them mistaken.

All that I intend or really do in the premises is to enter what may be termed a public caveat. I am firmly convinced that the end of this present century will see the advent of a new school of chemistry and physics which shall teach the way to technical progress far surpassing what has been accomplished under the doctrines hitherto accepted. I am not alone in this conviction; it is shared by many of the leading chemists of the day. I therefore conceive it a matter of scientific duty on my part to boldly throw down the glove of priority at the feet of my fellow-investigators. I issue my challenge to the whole world of science. If anyone thinks himself my predecessor in the art of transmuting metals, let him make public his claim. I will meet him, claim for claim, and proof for proof. If none take up my gage, my claim to be the pioneer and leader of the new chemistry will at least remain undisputed, and must be universally conceded whenever I may think proper to reveal its foundation of fact.

Stephen H. Emmens.

1 Broadway, New York, Oct. 1, 1896.

(In view of the present political situation, we cannot refrain from expressing regret that Mr. Emmens is not ready to prove at the present time that silver can be converted into gold.—Ed.)

Nicaragua Canal and Earthwork Slopes in the Tropics.

Sir: In the issue of your paper of Aug. 13 I find two letters which refer to a letter of mine published in your issue of the 25th June.

The letter of Mr. J. T. Ford shows the necessity for further surveys on the Atlantic slope of the Nicaragua Canal, but Mr. Ford seems to infer that there is no such necessity on the Pacific slope, and, furthermore, thinks that I am not familiar with the ground near the Pacific terminus. Now, it is because I am familiar with the ground, and have been in Salinas Bay (although not over the line I propose), that I believe a survey should be made from the Lake to this port. I will admit that the cost of the canal itself, between the Lake and Salinas Bay, will be somewhat larger than that of the present line, but I believe that a proper survey of this route will demonstrate that the cost of the canal would not greatly exceed the cost of the present location plus the cost of making a suitable port at Brito, nor would the Salinas Bay line be much, if any, longer than the present location of the canal. As far as I am aware no survey has ever been made of the Salinas Bay line, and one should certainly be made of this route before the final location is decided.

I do not know enough of the Colorado outlet as it is at present to confirm Mr. Ford's projected port at that place, but believe that proper surveys should be made to demonstrate whether it is practicable and better than the Greytown one or not. The whole Nicaragua Canal project requires more complete, more thorough and more extensive surveys before any further work be done thereon, and everyone interested in the successful conclusion of the canal should continue to din this into the ears of Congress until they appropriate a sum sufficient for these complete surveys.

With regard to the letter of Mr. Charles Thornton, if he had carefully perused mine of May 9, he would see that I referred particularly to the slopes of the cuts on the railway, and this in view of the report of the Commission. I certainly did not intend to intimate that any such slopes as one-half to one should be used in the canal excavation, although I fail to see why steep slopes should not be used above water line where the nature of the soil will admit, nor did I intend it to be inferred that embankments would stand at that slope. Mr. Thornton also says: "All of nature's laws are in full force in the tropics as elsewhere," to which I take exception, for, as I stated before, we have no frosts to contend with here, and everyone who has had experience in excavations in the temperate zone knows that frosts in that climate is a great disintegrator and destroyer of slopes of excavations.

Respectfully,

Silvanus Miller, M. Am. Soc. C. E.

Puerto Barrios, Guatemala, Sept. 18, 1896.

(Salinas Bay is about 20 miles due south of the canal strikes the west shore of Lake Nicaragua. It is on the boundary line betwen Nicaragua and Costa Rica.—Ed.)

THE PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTRICAL ENERGY.

(Concluded from Page 231.)

parently laid on the question of the reliability of the power. If the industries of a large city depended upon a single transmission plant, it is evident that the question of reliability is of paramount importance. Where energy is supplied to manufacturers, the street car systems, and for lighting, a break-down that would involve the cutting off of current for a day would mean an enormous pecuniary loss to the community. As the distance of transmission increases, the possibility of accident is increased in greater ratio because we have not only the higher voltages to control but the length of the line that must be looked out for is also increased. The best guide lies in the practical experience which has been obtained in the present transmission plants and the consideration of the difficulties that have arisen and the remedies that have been employed. I have prepared a partial list of the principal transmission plants that are now in operation.

It will be seen that the longest transmission is at Fresno, Cal., the distance being about 35 miles. The highest alternating voltage used is 13,000 volts at Zurich, Switzerland. The highest direct potential is 15,000 volts at Brescia.

All of these plants are working successfully, and this fact will lead to still longer transmission and higher voltages. No limit of either distance or potential has as yet been reached. It we consider the record of the present transmission plants, we can safely say that it would not be going outside of the safe limit of development to transmit at least 50 miles at a potential of 20,000 volts, provided the energy could be delivered at such a price as to be considerably lower than the cost of a corresponding amount of energy obtained from a steam plant. This, of course, is a matter of local condition entirely, and the commercial value of such a transmission will depend upon local conditions.

Long-Distance Transmission for Railway Work.

The possibility of long-distance electric railway lines is intimately connected with the possibility of long-distance transmission of power. We have seen that it is possible to transmit considerable distances from a single station. The current so distributed is not, however, such that it can be applied directly to railway motors, but it must be transformed at points along the line, the distance apart of these points of distribution depending upon the system that is employed. At present continuous current motors are used and considerations of safety would lead us to use line potentials not greater that 700 volts. By distributing rotary transformers at distances of five or six miles apart, we would be able to supply motors with current without any great investment in copper. The amount of copper required could still be further reduced by using rotary transformers with storage batteries, thus keeping a constant load on the transmission line. It will be found, however, that on any long-distance railroad line, the load on any section of the line is exceedingly variable and the discharge rate of the batteries will have to be very high in order to prevent excessive cost for our reducing stations. It is doubtful whether we have reached a point in battery construction that this system of transmission would be economical. It is certain, however, that when the distances are comparatively short, say, within 15 miles, and where the traffic is not evenly distributed, that rotary transformers, with or without batteries, can be economically employed for railway work.

Conclusion.

My conclusions, subject always to the influence of local conditions, are as follows:

1. In both direct-current lighting and traction systems, where the power is generated in or near the area of distribution, it is best to use one station situated at the most economical point for producing power.

2. In the case of the traction systems, when the economical area of direct distribution is passed, boosters should be employed directly or in connection with batteries, to a distance of ten or twelve miles from a station, and beyond this rotary transformers, whether with or without batteries, should be used.

3. In the case of direct-current lighting systems, the energy should be transmitted to storage batteries situated at centers of consumption either directly or by means of a rotary transformer and distributed from them.

4. Where batteries are used it is best to place them at the end of feeder wires to obtain the advantage of a constant load on the wire.

5. The best system for the long-distance transmission of energy, for general purposes, is the three-phase alternating system.

6. Commercial transmissions are in successful operation for distances of 35 miles, and for voltages as high as 15,000 volts.

Experience with these plants shows that the transmission of 50 miles with a pressure of 20,000 volts is practicable, beyond these limits the transmission would be more or less experimental.

THE NATIONAL BALL NOZZLE CO. is being sued, at Trenton, N. J., by the Columbia Hose Nozzle and the American Nozzle companies for an infringement of patent. The defendant answers that the essential and substantial features on which the patents are based were known, among others, to "One Herod, now deceased, but formerly of Alexandria, Egypt, living at said Alexandria and elsewhere 1,000 B. C."

A TAR FILLER FOR SOME OF THE JOINTS IN BRICK pavements has been used at Cortland, N. Y., in place of Portland cement, which was used for the main part of the work. The specifications for this work were written by Mr. Wm. B. Landreth, M. Am. Soc. C. E., who, at the suggestion of Mr. F. W. Dalrymple, Assoc. M. Am. Soc. C. E., City Engineer of Hornellsville, N. Y., called for a strip of the paving three joints wide along the crown of the street, and across the street every 100 ft., to be filled with common tar paving filler, to allow for a movement of the pavement, caused by the heat or the expansion of the cement in setting. One block of the pavement, 600 ft. long and 29 ft. wide, has been completed as above specified, the cement joints being filled with a high grade of American Portland cement. In three days after the joints had been filled the expansion began to force the tar filler from the joints, although the temperature had varied but little and at no time had exceeded 65° F.

The expansion seems to have been caused by the expansion of the cement in setting, although the cement was carefully tested for expansion before using. Since the cement became set hard the expansion seems to have ceased.

OLD BRICK ARE BEING USED instead of sand to make lime mortar, in the rebuilding of the new Union Station in Columbus, O. The refuse brick from the old walls are ground in a crusher. It is said that a quality of mortar for color work superior to that obtained with sand is produced.

A GREAT PLATE GIRDER, 54 ft. 6 ins. long, 6 ft. deep and 24 ft. wide, was hauled on a truck to one of the new buildings in Nassau St. The weight is said to have been about 32 tons, and 20 horses were required to haul it. It was built by the New Jersey Steel & Iron Co., of Trenton, N. J.

THE LOVE CONDUIT SYSTEM of electric street railways is to be installed on a quite extensive scale in Chicago, according to recent reports. The General Electric Ry. Co. of that city obtained some months ago a franchise for about 18 miles of line on the south side of the river, and it is upon this line that the conduit system is reported as to be used. According to the published statements of the General Electric Ry. Co., the work of construction is to begin at an early date, and besides this line, for which a franchise has already been secured, some 20 miles additional are to be built. The down-town terminus of the line will be at Jackson St. and will extend south as far as 57th St. The Love Traction Co. is reported to be the controlling interest in the scheme, but so little regarding the company's plans has been made public that it is impossible to give any definite statements regarding the prospects for construction.

GARBAGE UTILIZATION AT CINCINNATI AND NEW ORLEANS.

Of the 16 cities in the United States having populations of over 200,000 in 1890, there have already been established in ten cities, or soon will be, some improved system of garbage disposal. The 16 largest cities of the United States, in order of population, with the system of garbage disposal adopted, if any, are as follows:

City.	Population, 1890.	System.
New York	1,515,301	Utilization.
Chicago	1,099,850	None.
Philadelphia	1,046,964	Utilization and cremation
Brooklyn	806,343	None.
St. Louis	451,770	Utilization.
Boston	448,477	None.
Baltimore	434,439	None.
San Francisco	298,997	None.
Cincinnati	296,908	Utilization.
Cleveland	261,353	None.
Buffalo	255,664	Utilization.
New Orleans	242,039	Utilization.
Pittsburg	238,617	Utilization.
Washington	230,392	Cremation.
Detroit	205,876	Utilization.
Milwaukee	204,468	Utilization.

It is the purpose of this article to describe the utilization plants at Cincinnati and New Orleans, built under the Simonin system.*

The Simonin Process.

Before describing these two plants some information may be given regarding the Simonin system, though the details of this will be best understood by referring to the description of the Cincinnati plant, below, where the progress of the garbage during the whole process is described, as seen on the spot by our representative.

The patent on the Simonin system was issued on Jan. 5, 1892, to Chas. F. and Isaac M. Simonin, as No. 466,579, and is still controlled by these gentlemen, who have offices at Trenton Ave. and Clearfield St., Philadelphia, under the name of Simonin & Simonin. Regarding the development of the process and the plant at Providence, which latter has given rise to some misconception, Simonin & Simonin have given us the following information:

> This process was developed at Providence, in the works built by private parties to utilize the garbage of that city, by the Simonin & Adamson process. -This latter process not proving a financial success was discontinued. No city contract ever existed at Providence, but the garbage was delivered at the experimental plant by the garbage contractor.

The patent specification mentioned above describes a process for the removal of grease from garbage containing water, and the claims are for the combination by which this is effected, including the use of a heated liquid reagent, solvent to grease and of less specific gravity than water; the separation of the grease and water and the recovery of the reagent, together with the certain extractors, settlers, stills, cooling coils and means of connecting the same. The broad method of the extraction of fatty matters by means of benzine, naptha or other volatile reagents of low specific gravity is not claimed, this having "long been known and practiced."

The plant at New Orleans has been shut down for some months past, but the causes for this seem to be local, so we do not on that account refrain from making use of the detailed information so kindly furnished us, as acknowledged below, regarding the character and extent of the works. Both the New Orleans and Cincinnati plants have been visited by a member of our editorial staff, but circumstances were such that our representative could see and learn more of the workings of the Cincinnati than of the New Orleans plant, so it will be described first.

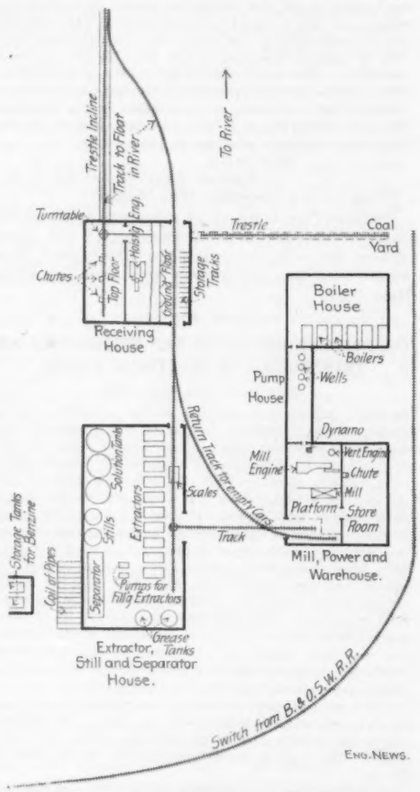
The Plant of the Sanitary Extracting Co. for the Treatment of the Garbage of Cincinnati.

We learn from Simonin & Simonin that the garbage of Cincinnati is treated under a contract running for ten years from June, 1892, the compensation being $15,000 for the first, $17,000 for the second, $19,000 for the third, $21,000 for the fourth, and then increasing $1,000 a year to $27,000 for the tenth year.

The following further information regarding the Cincinnati plant was obtained by our representative on a visit to Cincinnati, Dec. 24, 1895:

The garbage of the city of Cincinnati, O., is disposed of by the Sanitary Extracting Co., of that city. The president of the company is Senator J. B. Foraker and the secretary is Mr. E. F. Smith, both of Cincinnati.

The reduction plant of the Sanitary Extracting Co. is located near Riverside, a suburb, and about six miles from the business district of the city. The district is only sparsely built up and there are no houses within probably one-half mile of the works. The character of the dwellings indicates that the owners or occupants are people of very moderate means and in many cases (as indicated by the premises) not such as would be troubled by more than ordinary unsanitary conditions. It is said that complaints have never been made by these householders of any nuisance on account of the disposal works.



Sketch Plan of Garbage Disposal Plant at Cincinnati, O.

The plant occupies a tract of about five acres of ground lying between the north bank of the Ohio River and the tracks of the Baltimore & Ohio Southwestern R. R., and about 300 ft. distant from both the river and the railway. This ground is fenced in and no admittance is allowed except to employers and people on business. A written order is necessary to secure entrance. From the railway line a switch track enters the grounds. By means of this switch the works receive coal (at times) and other supplies, and ship away the grease and fertilizer. The grease is shipped away in tank cars supplied by the Standard Oil Co. Two tank cars were on the switch track on the day of the visit.

The accompanying illustration is a rough sketch plan of the works, which include a receiving house, extractor, still and separator house, mill, power and warehouse, pump house and boiler house. The sketch is not drawn to a scale.

The garbage is collected by the city and loaded into scows furnished by the company. Ordinary rectangular flat-bottomed wooden scows are furnished. When a scow is full, and not before, it is towed to the works. In summer about one scow is filled per day. At the time of the writer's visit about one scow per week was filled. The scows are furnished and the towing done by a local company under contract with the garbage company. The scows are anchored at a float in the river, and unloaded by hand into steel cars, of about 2,500 lbs. capacity, hopper-shaped, opening at bottom, of 4-ft. gage. During this loading of the cars all tin cans, etc., are separated from the garbage and left temporarily on the float. Afterwards the tin cans are taken from the float and dumped in a waste pile on the river bank. No use is made of tin cans. From the float a 4-ft. gage track runs up a trestle incline to the top floor of the receiving house. This track straddles the openings to the chutes leading from the top floor to the ground floor. The hoisting is done by a stationary engine and cable. There are three chutes, and four cars are used.

The hoisting engines for hauling the cars from the float to the receiving room are placed parallel and operate a single horizontal engine shaft which carries a pinion at its center. This pinion meshes with a spur keyed to a shaft on which the drums are mounted. These engines are a pair of 8×16-in. link motion reversing engines, from the I. & E. Greenwald Co., of Cincinnati. When possible, i. e., in summer, coal is received by scows unloaded at the float into the garbage cars, hauled to the turntable at the upper end of the incline, run onto the trestle and dumped into the coal yard. At other times it is received by the switch track. The garbage chutes discharge at the ground floor, this discharge being controlled by the necessary doors. A track on the ground floor runs directly under the discharge openings. In the Simonin process the garbage is loaded into a number of shallow pans perforated with numerous openings. A set or column of these pans is made by setting one on top of another, and the set or column carried on a metal truck. The truck, pans and all is run into the extractors. A tram car, with rails on top, runs on the track extending along the lower floor of the receiving, and to and into the extracting house. On this tram car is set the pan car. The pan cars with empty pans are stored on the storage tracks at one side of the main track in the receiving house, as shown in the sketch plan. A tram car is run onto the main track and stopped directly under a chute opening. A pan car is then run onto the tram car and blocked. The bottom pan is placed and filled; then the second pan is placed on top of the bottom pan and filled, then the third pan placed on top of the second pan and filled and so on until a "set" of pans is filled. The tram car is then run along the track to an empty extractor in the next building, and the pan car run off the tram car into the extractor, after being weighed on the scales. The head is then bolted onto the extractor and the process of extraction begun. The lids of the extractor, which are of cast iron, and very heavy, are handled by an overhead trolley.

As will be seen from the sketch plan, there are ten extractors; each is a 6×22-ft. cylinder, standing horizontally. When the car load of garbage has been fastened into an extractor, benzine is forced into the extractor until it is filled, by means of one of the pumps near by. After the benzine has taken up all the grease the solution of grease, benzine and water is forced into the three solution tanks. The solution then passes into the two adjoining stills, where the benzine and water are vaporized and sent into the coil of pipes, shown just outside the building. A constant cascade of cold water flows over the pipes, thus condensing both the steam and benzine vapor, which flow as liquids into the separator. The benzine is then taken off the water and conveyed to the storage tanks, shown in the separate building near by. The grease which remains in the stills is passed into one of the two storage tanks, in a corner of the building, where it is ready for shipment. Only one storage tank is used at a time, the other being held in reserve.

Meanwhile the solid matter in the pans in the extractor has been thoroughly dried by the steam heat. The head is taken off the extractor and the car, with its set of pans filled with dry "tankage," is hauled out, weighed and run onto a tram car

*Of the ten utilization plants included in the above list, those at St. Louis, Buffalo, Detroit and Milwaukee employ the Merz process, and were described at length in our issue of Nov. 1, 1894. At Pittsburg, the system controlled by the Consolidated American Reduction Co., and described in our issue of Oct. 3, 1895, was installed. The plant at New York will employ the Arnold process, which, as temporarily used in Boston, was described in Engineering News of March 28, 1895.

and the tram car run along a track to the mill room. Each pan is dumped onto a platform in front of the mill. As each pan is dumped it is placed on a pan car, which is placed in turn on a tram car standing on an adjoining track. By this process the top pan of the first carload becomes the bottom pan of the second carload of "empties," which latter are sent back to the storage tracks.

From the platform the tankage is shoveled into the mill and ground. A continuous bucket elevator takes the ground matter and conveys it to the second story, where it is dumped onto a sieve. The material passing the sieve falls into a chute which opens into the storage room. The bags are hung under a spout and filled. They are then stored for shipment.

The power room contains the engine for operating the mill and a vertical engine for operating an electric light dynamo. The mill engine is a 12×30-in. cylinder, automatic cut off, trip valve engine of the Brown type, and was furnished by the I. & E. Greenwald Co., of Cincinnati. Between the mill and boiler houses is the pump house, beneath which four wells, 100 ft. deep, supply the water. The water is pumped by four Laidlaw-Dunn-Gordon standard No. 4,040 deep well pumps. The water is forced onto the coil of pipes and then runs into an earth reservoir. The overflow from this reservoir drains along the surface of the ground to the river.

The boiler room contains six 16×5½ ft., 54 4-in. tubular boilers built by McIlvane & Speigel, of Cincinnati, O. Steam pipes run to the various engines and to the extractors, stills, etc., in the extractor house.

The extractor house is built of brick, but the other buildings are of wood, covered with corrugated iron. There are 46 "sets" of pans used altogether. About 24 men are employed at the works in the winter, and during the summer months four or five additional men are employed in unloading the garbage and other rough labor. No exhaust fans are used anywhere about the building. The plant is operated continuously as long as there is garbage.

Garbage Collection at Cincinnati.

The following information regarding the collection of garbage in Cincinnati was obtained from Mr. Fred. Amthauer, Superintendent of the Street Cleaning Department:

The garbage of the city of Cincinnati, O., is collected by the street cleaning department and expenses are paid from the general fund appropriated for street cleaning. Garbage collection in that city is thus a part of the work of cleaning the streets, and no especial provision is made for doing it. In collecting, the ordinary tight board wagons used for collecting ashes are used, the garbage being covered simply with a tarpaulin. The wagons are used interchangeably for collecting garbage and ashes. For example, a wagon may work half a day hauling garbage and the other half day hauling ashes. One day two wagons will haul garbage to every one which hauls ashes, while on the next day the exact contrary disposition of the wagons will be made, two wagons ashes to one wagon garbage. In winter, when the garbage can stand longer without offense and the snow and mud is the worst, street cleaning is placed first and garbage collection second. In summer the garbage is collected first and the streets cleaned second.

In the most populous districts garbage is collected daily during the summer. Elsewhere the collections are made every second or third day, as the conditions seem to demand. In winter collections are made less often everywhere. In other words, the superintendent of street cleaning uses his discretion in making the collections more or less frequent, the only point observed being to keep the garbage receptacles clean and inoffensive. It is intended always to keep the garbage inoffensive even at the expense of dirty streets.

Ashes are forbidden to be mixed with the garbage proper, but no reservation is made as to the inclusion of tin cans, bottles, etc. Of course, householders occasionally mix their ashes and garbage, and then the drivers refuse to take the mixture. Generally warning from the health officer is enough to stop the trouble, but occasionally fine and arrest is necessary.

It is realized that the education of the householders is as much the duty of the health officer as fines and arrests, and care is taken to instruct them not to mix garbage and ashes. The drivers of the collecting wagons and sanitary inspectors are instructed to warn careless persons and new householders. In addition, thousands of circular sheets of instruction are distributed annually.

No special receptacle is required to be provided by the householder and consequently a great variety of forms are used. The superintendent of street cleaning makes complaint of this, and says the work of collection would be lightened by having a common size and form of receptacle.

The garbage is all hauled to a scow provided by the Sanitary Extracting Co. and unloaded, after which the street department has nothing further to do with it. At this scow most of the tin sans, bottles, etc., are taken by junk men who seem willing to separate them from the garbage for what they can make from the salvage. A few cans and bottles, of course, remain and these are separated at the garbage plant.

From the big hotels the garbage is collected by the Sanitary Extracting Co., which has one wagon for that purpose. This is the only garbage collected by the company and which the street cleaning department does not collect. (Dead animals not included.)

Dead animals are removed without expense to the city by the Jones Fertilizing Co., which gets its compensation from the hides, grease, manure, etc. The Sanitary Extracting Co. does not handle dead animals at all. The Jones Fertilizing Co. is supposed to collect all animals, but the city wagons usually take in small animals whenever they come across them.

After unloading each wagon at the garbage scow it is flushed out with a few bucketsful of water, and before going into the stable at night it is washed with a hose and sprayed with a solution of copperas and water. The scow stands at its dock until it is filled.

A record of the loads of garbage hauled to the scow is kept, but no record of weight. As a matter of curiosity the garbage was weighed for a day or two and it was found that the loads weighed from 1,900 lbs. to 3,200 lbs. and averaged about 2,500 lbs. During the year 1894, 13,894 loads of garbage were hauled to the scow, which on the basis of the above average would be 17,368 tons. A daily record of the number of loads hauled during the month of August, 1894, is appended as follows:

Day.	Loads.	Day.	Loads.	Day.	Loads.	Day.	Loads.
1	41	10	77	18	3	26	78
2	99	11	3	19	101	27	92
3	71	12	98	20	78	28	75
4	3	13	85	21	57	29	48
5	90	14	58	22	52	30	92
6	90	15	49	23	89	31	81
7	57	16	92	24	89		
8	52	17	80	25	3	Total.	2,053
9	79						

At an average of 2,500 lbs. per load the amount of garbage collected in August would be 2,566 tons.

Dr. J. W. Prendergast, Health Officer, says that the disposal of garbage by the Sanitary Extracting Co. has caused no nuisance and is sanitary.

The Contract and Works of the Southern Chemical & Fertilizing Co. at New Orleans.

On March 15, 1894, a contract went into effect between the Southern Chemical & Fertilizing Co. and the City of New Orleans for the collection and disposal of the garbage, dead animals, ashes, street sweepings and general house and store refuse of the city, for a term of 20 years. The contract, we are informed, was based on an ordinance directing the comptroller to call for bids for this work and containing specifications for it. This ordinance provided that no contract should be closed

> until the successful bidder has presented a system of disposing of refuse vegetable and animal matter, including dead animals, in a manner which is scientific and sanitary, disposing of whatever is injurious to health and discomforting to the human race, at the same time preserving whatever is valuable in the material aforesaid.

Another part of the ordinance required the erection of a cremation or utilization plant.

The ordinance also provided that the means and methods provided and employed in collecting and treating the garbage should be satisfactory to the State Board of Health of Louisiana.

Garbage and dead animals were to be collected daily; street sweepings when the department of public works should direct, the latter to be gathered into piles by the department.

One section of the ordinance defined garbage and prohibited its mixing by house-holders with other matter, as follows:

> Sec. 4. Be it further ordained, etc., that the word "garbage" as used in this ordinance shall be construed to mean house and kitchen offal, and all refuse matter not excremental, whether solid or liquid, and composed of animal and vegetable substances, including dead animals coming from public or private premises of the city, and not destined for consumption as food. No ashes, dirt or other substances foreign to garbage shall be covered by this contract, except as hereinafter provided, and it shall be unlawful for any occupant or occupants of any premises in the city of New Orleans, to mix any such ashes, dirt, or other substance foreign to garbage, with the garbage to be removed from said premises as herein provided, under a penalty of not less than $5, nor more than $25 fine for each offense, or imprisonment for not more than 30 days.

Householders were required to deposit their garbage in covered metallic vessels and the contractor was required to use "inclosed, water-tight metallic vehicles" for removing the garbage.

The garbage wagon afterwards adopted by the contractor was illustrated and described in our issue of May 17, 1894.

The contract price for performing the services outlined above was $120,000 a year for the first five years, $134,000 for the second, $150,000 for the third, and $165,000 a year for the fourth five years. This amounted to a total of $2,845,000, or an average of $142,250 per year.

The company selected the Simonin process for the treatment of the garbage and erected an extensive plant. The following description of the plant has been prepared from information furnished us under date of Feb. 11, 1896, by Mr. T. A. Clayton, who was at that time General Superintendent of the Southern Chemical & Fertilizing Co.

The company began work on July 11, 1894, and has continued its collections since that time, but the disposal works have been shut down since Nov. 20, 1895, "partly on account of the low prices obtainable for the product, but chiefly on account of the difficulty in getting the citizens to refrain from mixing their garbage with ashes and other foreign matter." During the construction of the plant Simonin & Simonin were represented by Mr. W. H. Hughes, of Providence, R. I. Mr. Clayton states that many improvements have since been made. The plant has a guaranteed daily capacity of 75 tons of drained or about 100 to 125 tons of wet garbage.

The disposal works are located seven blocks from Canal St. and 34 blocks from the river. A switch runs into the works from the Mississippi Valley R. R. The New Basin Canal, which runs from the heart of the city into Lake Pontchartrain, is about 120 ft. distant.

Eight buildings house the plant, their character and uses being as follows: A pocket house for the reception of garbage and a rendering house for the treatment of dead animals, in one building 60×100 ft., 40 ft. to the ridge; brick, with slate roof. Attached to this is an inclined run for the garbage and dead animal wagons to get up to discharge their loads. This run is inclosed, covered with galvanized iron, and the lower part is used for a stable. An extractor room, 75×100 ft., 40 ft. to the ridge; of brick covered with slate, in which are contained the extractors, stills, solution and grease tanks. A brick building, slate covered, 60×183 ft. and 35 ft. in height to the ridge, of which 62 ft. contain the boiler and engine room, 35 ft. the mill room, 40 ft. a warehouse, and 46 ft. another warehouse, all divided by fire walls. A brick building covered with galvanized iron, 50×100 ft. used as a stable. A frame building, inclosed and covered with corrugated iron, 37×50 ft., two stories, with the lower story used as a blacksmith shop, etc., the upper story a machine shop, and having attached a cupola for melting tin cans and old metal of all sorts. A corrugated iron building, 30×65 ft., by 30 ft. high, inclosing a crematory for the destruction of garbage, etc. A frame building, 23×31 ft., containing the naphtha tanks, and a brick slate covered office 25×32 ft.

The steam plant consists of six 150-HP. horizontal tubular boilers. There are four engines. Of these, a 75-HP. Greenwald engine drives the

grinding mill; a 15-HP. New York Safety runs the electric plant; a 10-HP. Racine engine drives an 18-in. exhaust fan used in connection with the rendering tanks for treating the dead animals; and a 15-HP. engine is provided for the cupola blast and for driving the machinery in the machine shop.

Two 12×10½×12-in. pumps are used to pump water over the condensing coils; a 7½×4½×10-in. pump is used for boiler feed; and two, 6×6×12-in. pumps for lifting the naphtha into the extractors. All these are Blake pumps. The water supply is from a 730-ft. artesian well and the canal. The utilization plant requires the use of 800,000 to 900,000 gallons daily, but when cremating the garbage only a few thousand gallons a day are consumed. From this statement it might be inferred that the garbage is burned when not treated by the utilization process.

There are two iron smoke stacks, one 52 ins. in diameter and the other 60 ins., each 80 ft. high, the top of one being 104 and the other 102 ft. above the ground.

The nine extractors are 6 ft. in diameter and 22 ft. long, and were made by McIlvain & Spiegel, of Cincinnati. The extractors are so connected that the steam and naphtha can be passed from one to another, if desired, thus economizing steam and saving the work to be done by the condensing coils. The stills for separating the naphtha and grease are two in number, each 6×15 ft. Steam coils run through these stills.

The tankage is ground, so far as necessary, by a 4-ft. Luttner cage mill with a daily capacity of 12 to 15 tons, according to the quality of the material.

When the plant is in operation about 20 unskilled laborers are employed at $1.50 a day; two firemen at $2 a day; and three skilled laborers at $2.50 a day. The plant is operated night and day and from November, 1894, to October, 1895, 14,300 tons of drained garbage was treated, to which 40% must be added, Mr. Clayton states, to get the weight of the equivalent amount of green garbage. The daily record of drained garbage treated in June, 1895, is as follows:

June	Lbs.	June	Lbs.	June	Lbs.
1.....	50,178	12.....	60,730	23.....	46,810
2.....	43,900	13.....	67,930	24.....	60,990
3.....	61,264	14.....	60,020	25.....	38,128
4.....	24,490	15.....	68,380	26.....	68,614
5.....	90,480	16.....	38,070	27.....	63,360
6.....	73,184	17.....	66,450	28.....	63,708
7.....	78,108	18.....	63,233	29.....	65,274
8.....	68,360	19.....	48,560	30.....	54,514
9.....	53,200	20.....	96,290		
10.....	62,162	21.....	46,680	Total.	1,850,418
11.....	64,858	22.....	84,383		

The amount of grease derived from the garbage is given as 5 to 7%, and of tankage for fertilizing purposes, 25 to 30%, both by weight. The only material taken to the works which cannot be reduced is paper, rags, feathers and similar wastes, which, being very dry, are burned under the boilers. The waste liquids are run into the sewer.

The following information regarding the New Orleans plant was obtained by a member of the editorial staff of this journal during a visit to the plant in the fall of 1895:

The statement made by Mr. Clayton regarding the location of the plant may give the impression that the plant is not far from the thickly settled part of the city. Such is not the case. Canal St. extends north, slightly west from the river front, toward Lake Pontchartrain, and while a principal street its northern end penetrates a sparsely settled and poor quarter of the city. The houses are 1 and 1½ story frame structures and seem to be inhabited chiefly by negroes.

The most unsanitary things seen about the works were a dozen or so empty and uncleaned iron collecting wagons. Inclosed by a fence were the buildings of the plant, much the handsomest and best constructed buildings of any plant seen by our representative, except, possibly, those at St. Louis. Much of the area between buildings was paved with concrete or cement, and except where piles of dry refuse from the extractors temporarily existed until used in a further process, this pavement was very clean and dry. Inside the buildings there was the usual sour smell of green garbage and the odor of fertilizer, but only where the dead animals were handled were things very offensive, and then only in the building itself. A smelling excursion around the building did not impress one with the idea of there being any nuisance, and the day was hot and a slight breeze blowing. In point of odor this plant may be placed ahead of that at Cincinnati.

The impression received regarding the crematories was that they were used to handle garbage of very little value for extraction or otherwise unfit for the process by the admixture of ashes.

Since our representative visited the plant and since Mr. Clayton gave us the information quoted above the city has attempted to annul the contract with the company on the ground of non-fulfillment. After this action a receiver, Mr. Algernon A. Badgley, was appointed and he has appealed to the Federal Court to enforce the payment of the monthly sums stipulated in the contract and to prevent collection of garbage by the city. The following statement regarding the controversy has been prepared for us by Dr. Quitman Kohnke, chairman of the public health committee of the city council:

The fight between the city and the garbage company (The Southern Chemical & Fertilizing Co.) need not reflect upon the efficacy of the "Simonin process" to dispose of garbage, but was brought about by violation of the sanitary laws on the part of the garbage company. It is charged that the company established dumping grounds within the city limits, some of these being on public thoroughfares where the collected garbage was deposited contrary to law and contract, and in violation of ordinary rules of health. It is claimed by the company that such disposition of garbage was made necessary by reason of the failure on the part of the householder to separate the garbage proper from the ashes and trash. On the other hand, it is claimed by the city that the company encouraged and assisted in the mixing of garbage and trash and deposited on the various dumping grounds pure garbage unmixed with ashes or trash—the real reason for dumping being that the increased price of naphtha and the decreased value of the products of the plant rendered it unprofitable to treat the collected refuse in the manner originally contemplated.

Whether the company is released from its obligation to collect and dispose of garbage by reason of non-compliance on the part of the householder with that part of the contract providing for the separation of garbage from trash, will be decided by the courts. The position of the city appears to be that the company is obligated to remove and dispose of all garbage, mixed or unmixed, inasmuch as all others are expressly forbidden to remove it, it being incumbent upon the company to invoke the law against the householder who does not separate his garbage. A general complaint has been made by the company, but in no case has an individual householder been charged with violation of the law. This failure on the part of the company to prosecute the householder is supposed to have been due to fear that the law would be declared unconstitutional which compelled a citizen to perform without compensation a menial service for the benefit of a private corporation.

The position of the Board of Health in this matter is that it recognizes no contract, but insists upon the prompt collection of all garbage and the suppression of dumping grounds for such refuse.

Under date of Sept. 28, 1896, Mr. Clayton wrote us further regarding the status of garbage disposal in New Orleans, as follows:

It is a fact that when we are not using the reduction process we cremate the garbage in crematories that give perfect satisfaction in every way, and which I believe are the best and most economical in operation. These crematories are of our own design and construction, and are unique.

With regard to the actual situation here in connection with the present status of the garbage disposal, I would say that our company is still collecting the unmixed garbage that is exposed by the citizens, transferring it to the plant and cremating it. The mixed garbage is being collected to a certain extent by the city. The authorities have refused to enforce the law which governs our contract with regard to the due obligation of house-holders to keep their garbage separate from foreign material, and are attempting to declare our contract null and void. The matter has been taken into the United States Courts through the appointment of a receiver, named at the request of some of the bondholders who live outside this state, and the case will come up in November, when we are confident of winning the suit.

The city has gone back to the old system of sending garbage down the river and dumping it below the city limits, but their system is poorly organized, and is evidently of a temporary character.

From all we can learn on the subject, including reports of discussions in and out of the city council and statements by representatives of the company, it appears that the people of New Orleans awoke, after it was too late, to a realizing sense that Sec. 4 of the ordinance, quoted above, requires the separation of garbage from ashes and other refuse and rebelled against it. The requirement is a perfectly reasonable one, is a part of the contract, and essential to the successful operation of the plant required by the contract.

Whether it rests with the city officials or the garbage company to compel householders to separate the garbage, or whether the refusal of the company to collect mixed garbage is the proper course for it to pursue to secure its rights are questions now before the court.

In so far as the questions involved have any bearing upon the Simonin system of garbage disposal they apply equally to all other reduction or utilization systems in successful operation and must also be considered in connection with cremation, or even dumping at sea. We have discussed this matter further in our editorial columns.

THE INTERSTATE COMMERCE COMMISSION'S STATISTICS OF THE RAILWAYS OF THE UNITED STATES FOR THE YEAR ENDING JUNE 30, 1895.

An advance abstract of this report, as furnished by Prof. Henry C. Adams, the statistician of the Interstate Commerce Commission, was published in our issue of July 30; but from the full report, advance proofs of which have just been issued, much other interesting information can be gleaned relating to the status of the railways of the country up to the date of the report. The summary of mileage, equipment, classification, capitalization, earnings and expenses was given in the statement already published, but some of these will be repeated here in going into the details of the full report.

This report differs from its predecessors in not only making comparisons with the previous year, but in including, as far as possible, the years 1890 to 1894 inclusive. These six years, including 1895, cover a period of unusual commercial conditions, and the broader comparative statement is useful in any attempt to investigate and better understand the influences at work and their effect upon railways.

The Commission places the aggregate mileage of railways in the United States, on June 30, 1895, at 180,657, an increase during the year of only 1,949 miles, or 1.09%, which is less than the 1.27% of increase of 1894, the lowest in any year since the Commission was organized. In figuring out the miles of line per 100 square miles of territory for the whole United States there is, of course, a steady but slow increase, from 5.51 miles in 1890 to 6.08 miles in 1895. But population has been gaining upon railway construction in the same period, as is shown by the fact that in 1890 there were 26.05 miles of line to every 10,000 inhabitants, with a maximum of 26.51 miles in 1893 and a present ratio of 26.16 miles per 10,000 inhabitants. The report does not assume from this that there is any tendency towards a permanent change in commercial forces, and contends that until there is a more even distribution of railway facilities than there is at present, railways must still remain as the pioneers in industrial development. In looking over the summary of railway mileage for each state and territory there is still natually a wide diversity of percentage as effected by geographical position, age, density of population and facilities for producing goods for transport. Under the head of miles of line per 100 square miles of territory and omitting the small District of Columbia with 47.62 miles, we find New Jersey in the lead with 29.72 miles; closely followed by Massachusetts with 26.35 miles; Pennsylvania, Ohio, Connecticut and Illinois come next, with 21.67, 21.13, 20.81 and 19.02 miles respectively. The State of Nevada has only 0.83 miles per 100 square miles of territory; Oklahoma has 0.98 miles; Wyoming, 1.21 miles; Arizona, 1.22 miles, and Idaho, 1.29 miles. But these new and thinly settled states and territories, of course, rank highest in the ratio of miles of railway to 10,000 inhabitants; Arizona, Montana and Nevada having 208.51, 195.55 and 182.65 miles, respectively, as compared with 5.82 miles per 10,000 inhabitants in Rhode Island and 8.61 miles in Massachusetts.

In the year covered by the report there is still evident a slightly stronger tendency towards the development of existing property rather than to attempt to gain new traffic by extending lines. The percentage of increase in single track for the year 1895 was 1.09, that of second track was 1.34, of third track 2.32 and of fourth track 3.11%; the increase in yard track and sidings was 2.87%. The tendency towards consolidation of interests and greater simplicity in organization and operation is more marked than in previous years. Between 1890 and 1895, inclusive, there has been a decided decrease in lines operated under lease and contract, and a gain in lines owned, from 90,931

miles in 1890 to 125,334 miles in 1895. As showing the general tendency, it may be stated that while the increase in lines owned, between 1890 and 1895, was 25,404 miles, the aggregate extension of railway mileage in that time was only 17,060 miles. The Commission believes that this movement towards greater consolidation will tend to reduce the intricacies of intercorporate contracts which now so much embarrass those seeking to fairly understand the railway system of the United States. From a summary given it appears that 42 railway corporations now operate 100,714 miles of line, or 55.67% of the total mileage; but it may be said here, that for roads operating lines from 250 to 400 miles long and below 250 miles, the percentage of aggregate mileage was about the same in 1895 as in 1890. Of the corporations operating lines over 1,000 miles long, 40 controlled 47.51% of the aggregate mileage, in 1890; showing a general increase of over 5% in lines of that class in six years.

The equipment summaries of the report are especially interesting. With a total of 35,699 locomotives, on June 30, 1895, the increase over the previous year was 207, as compared with an average annual increase of 1,112 for the period 1890-1895 inclusive. The number of cars in service, at the date of the report, was 1,270,561, a decrease of 7,517 as compared with 1894. The freight cars showed a decrease of 9,050, and the passenger cars an increase of 94, and the cars assigned to company service an increase of 1,439. The decrease in the number of freight cars is partly ascribed to the increased use which railways make of private cars; and it is possible that the opportunity presented by slack business for the destruction of a larger number than usual of old and inferior cars may also account for some of the reduction. The average amount of equipment per 100 miles of line changed little or nothing from the year before; the proportion, in 1895, being 20 locomotives and 715 cars, of all types. The assignment of equipment to the amount of traffic, as compared with 1894, shows a decreased efficiency in passenger service and an increased efficiency in freight service. The first is probably due to decreased travel as a result of business depression, and it also suggests that travel has returned to normal conditions after being disturbed for some time by the Columbian Exposition. The freight service shows on its face increased economy in transportation; but the figures are not satisfactory as a large portion of freight moved in cars not owned by railway corporations is necessarily omitted from the computations. The assignment of equipment to the amount of travel, for the two years, is thus summarized:

	1894.	1895.
Passengers carried per pass. locomotive	54,654	50,747
Passenger miles per pass. locomotive	1,444,400	1,218,967
Tons carried per freight locomotive	31,909	34,817
Ton-miles per freight locomotive	4,016,755	4,258,821
Passenger cars per million passengers	53	65
Freight cars per million tons freight	1,888	1,717

The report gives the rate of equipment with automatic couplers and train brakes, since 1889, as follows:

Year.	Total equipment.	Increase	Equipment.[1]	Increase	Equipment.[2]	Increase
1895	1,306,260	*7,310	362,498	31,506	408,856	51,235
1894	1,313,570	4,836	330,992	31,965	357,621	35,383
1893	1,308,734	60,506	299,027	42,158	322,238	77,904
1892	1,248,228	27,139	256,869	68,537	244,334	75,299
1891	1,221,089	21,282	188,332	39,505	169,035	55,716
1890	1,199,807	101,205	148,827	20,068	115,319	34,809
1889	1,098,602	....	128,159	....	80,510	....

*Decrease. [1]Fitted with train brakes. [2]Fitted with automatic couplers.

From this statement it is very evident that the law will not be complied with, which requires freight cars to be fitted with train brakes and automatic couplers by January, 1898. The distribution of this equipment so far as cars of various types are concerned, may be given as follows from the various summaries in the report:

Type of car.	Number equipped with train brake. 1894.	Number equipped with train brake. 1895.	Number equipped with automatic coupler. 1894.	Number equipped with automatic coupler. 1895.	Total cars in service.* 1894.	Total cars in service.* 1895.	Total in 1895 still to be equipped, with train brakes.	Total in 1895 still to be equipped, with auto. c'pl'rs.
Passenger	32,403	32,384	31,916	31,971	33,018	33,112	728	1,141
Freight service	264,884	295,073	317,596	366,985	1,205,169	1,196,119	901,046	829,134
Company service	4,406	4,976	2,676	3,438	39,891	41,330	36,354	37,892
Total	301,753	332,433	352,488	402,394	1,278,078	1,270,561	938,128	868,167
Leased	40,587	38,888	63,906	50,029	181,684	178,107	139,219	119,078
Fast freight	11,510	18,982	16,811	23,122	44,212	49,472	30,490	26,350

*Equipped and unequipped.

So far as locomotives are concerned, practically all passenger locomotives are equipped with train brakes; but 6,106 are still without automatic couplers, out of a total of 9,999 of this class in 1895. Out of 20,012 freight locomotives 16,712 were fitted with train brakes and only 2,039 with automatic couplers, on June 30, 1895. The report gives in detail the types of train brake and automatic coupler in use throughout the United States.

On June 30, 1895, there were 785,034 men of all classes in the employ of railway corporations, as compared with 779,608 in 1894, and 873,602 in 1893. Since 1893 the total number of men employed for each 100 miles of line has decreased from 515 to 441; but the number of men assigned to maintenance of way and structures, per 100 miles of line, was 151 in 1893, 123 in 1894 and 128 in 1895, showing a slight increase in this class of labor in the last year. The number of men assigned to maintenance of equipment, for the same unit of line was 103 in 1893, 86 in 1894 and 88 in 1895; for men engaged in conducting transportation, the ratio was 234 in 1893, 208 in 1894 and 204 in 1895.

From statements of the capitalization and valuation of railway property in the United States on June 30, 1895, the following comparative summary is prepared:

	1890.	1895.
Total stock	$4,409,658,485	$4,961,258,656
Stock per mile of line	28,194	28,602
Total funded debt	4,574,576,131	5,385,495,573
Bonds per mile of line	29,249	31,048
Other indebtedness	453,108,804	616,830,156
Per mile of line	2,958	3,556
Total railway capital	$9,437,343,420	$10,963,584,385
Total, per mile of line	60,340	63,206

From another table given it is shown that on June 30, 1895, railway corporations owned 23.57% of all the outstanding stock and almost 10% of the outstanding bonds; the amounts of both held by these corporations being considerably larger than in the previous year; a fact that may be ascribed to railway consolidation rather than to any strengthening of reserve funds. The summary of stocks and bonds paying dividends and interest shows that during 1895 70.06% of all the outstanding stock paid no dividends and 16.71% of the funded debt paid no interest. This is the largest failure in payment, for both classes of securities, for any one year since the Commission was organized. The percentage of dividend paying stocks has decreased from 38.56% in 1888 to 29.95% in 1895.

The comparative passenger and freight service for the years ending June 30, 1890, 1894 and 1895 are summarized as follows:

	1890.	1894.	1895.
Pass. carried	492,430,865	540,688,190	507,421,362
Per mile of line	75,751	81,333	68,572
Tons:			
Freight car'd.	636,541,617	638,186,553	696,761,171
Car'd 1 mile	76,207,047,298	80,335,104,702	85,227,515,891
Average haul*	119.72	125.88	122.32

*Per ton-mile.

These figures indicate a marked decrease in the number of passengers carried in 1895 as compared with the previous year; but the freight traffic shows an increase over 1894. The gross income from the operation of the railways of the United States for the year ending June 30, 1895, was $1,075,371,462, an increase of $2,009,665 over 1894. For the same period the expenses of operation were $725,720,415, a decrease of $5,693,907 over 1894. The net income from operations was $349,651,047, an increase of $7,703,572 over 1894, but excepting that year it is the least of any year since 1890. The earnings from passengers, in 1895, amounted to 29.16% and that from freight to 68.27% of the total earnings from operation. The percentage of operating expenses to operating income is gradually increasing; this item being 65.80% in 1890; 66.73 in 1891; 66.67 in 1892; 67.82 in 1893; 68.14 in 1894 and 67.48% in 1895.

The Commission gives a general summary of results, as deduced from their numerous tables, covering the period 1890-1895 inclusive, and the whole United States. This table is interesting as showing the late trend in revenue and cost of operation and it is given in full as follows, the cents being reduced to the nearest decimal:

Item.	1895.	1894.	1893.	1892.	1891.	1890.
Revenue per passenger per mile	$0.02040	$0.01986	$0.02108	$0.02126	$0.02142	$0.02167
" per ton of freight per mile	.0839	.0860	.0878	.0898	.0905	.0941
" per passenger train-mile	.98	1.05	1.07	1.07	1.06	1.08
" per freight train-mile	1.61	1.56	1.63	1.65	1.64	1.65
" per train-mile, all trains	1.36	1.37	1.43	1.45	1.43	1.44
Average cost of running a train 1 mile, all trains	.09182	.09348	.09727	.09958	.09571	.09901
Per cent of operating expenses to operating income	67.48	68.14	67.82	66.67	66.73	65.80

Had the rates of 1890 been maintained in 1895 the passenger revenue would have been increased for the latter year by $15,479,326, and the freight revenue by $86,932,066. From this it appears that if we take the rates of 1890 as a standard, the people of the United States have saved, in passenger and freight charges in a single year, a sum exceeding $100,000,000. With the above statement and as illustrating the effect of the business depression upon railways, the report states that as contrasted with a surplus from operations of $8,116,745 in 1893 and $14,036,056 in 1892, 1894 showed a deficit from operations of $45,851,294, and 1895 shows a deficit of $29,845,241.

The length of line operated by the 75 companies whose gross annual revenue exceeds $3,000,000, is 119,810 miles, or 67.41% of the total operated mileage. The aggregate revenue of these 75 companies is $874,542,695, or 81.32% of the total gross revenue for the entire country, which was $1,075,371,462. For these companies the average gross revenue per mile was $7,299 as compared with $6,050, the average per mile of line of all roads; they perform 84.08% of all the passenger service and 84.55% of the total freight service. The chief interest centers in the fact that while this group of roads enjoyed a net revenue of $2,862 per mile of line in 1890 this was reduced to $2,425 in 1895; a decrease of $437 per mile of line, equivalent to a total reduction of about $50,000,000 in net revenue, for 1895, for the roads under consideration.

The total number of railway employes killed in 1895 was 1,811 and 25,696 were injured. This is a decrease, over 1894, of 12 killed and an increase of 2,274 injured. Of passengers, 170 were killed and 2,375 injured; a decrease of 154 over the killed and 659 in those injured in 1894. The record for 1895, in respect to the number of passenger casualties is less than for any year for which complete statistics are available. The statement of "other persons" for 1895, foots up 4,155 killed and 5,077 injured, as returned to the Commission. The total chargeable to railway accidents, for 1895, is 6,136 killed and 33,748 injured. A summary of employes and passengers killed and injured in the United States in 1890-1895 shows that the record for 1895 is more satisfactory than for any previous year of record; the number of employes killed has decreased from 1 in 306 to 1 in 433, while those injured have decreased to 1 in 33 from 1 in 31 in 1890. The number of passengers killed was 1 in 1,727,780 in 1890, and 1 in 2,984,832 in 1895; while the proportion of passengers injured has decreased from 1 in 203,064 in 1890, to 1 in 213,651 in 1895. The Commission believes that the fitting of equipment with automatic devices is beginning to show a beneficial effect; as while 1 trainman in every 105 was killed in 1890, the ratio in 1895 was 1 to 155.

The Commission renews its recommendations of previous years, and further recommends that Congress establish a Bureau of Statistics and Accounts, which shall have the right of inspection and control of the accounting departments of the common carriers. This bureau was suggested in the ninth annual report of the Commission and the considerations favoring it are given in full.

A NEW WATER-METER.

A simple form of positive water meter adopted for general service has recently been perfected by the National Meter Co., of New York city, by making some important changes in its "Empire" meter. This meter has been in use for a number of years, but principally for measuring hot water and other liquids requiring all-metal construction.

The general design of the new meter is shown by the accompanying illustrations, Figs. 1 to 3. Fig. 1 shows the cylinder and piston, the top cylinder head being thrown back to show the piston in place, Fig. 2 shows the base and screen, and Fig. 3 the whole meter, in two parts, the cover being thrown back to show the intermediate gearing.

The piston is of hard rubber, having the same specific gravity as water. It has a revolving motion around the centre of the case and an oscillating motion on its axis.

The base casting is made considerably thinner than the cap, and the bulk of the water in the meter being in the base, in case freezing occurs, the base will be the only part injured, and the moving parts, register, etc., will not be affected. This greatly simplifies and cheapens the work of repairing frozen meters.

The meter has a straight reading register, which is instantly read without liability to error, and is provided with the same style of intermediate gearing that is used in the Crown and Nash meters, made by the same company.

Another point claimed for the meter is that if the piston stops for any reason it shuts off 85% of the normal flow through it. By this means the consumer, while not absolutely deprived of water, is pretty sure to notify the water department, or otherwise see that the meter is set right, instead of placidly continuing to use the water without having it charged against him.

The old meter, designed, as stated, for special service, had a gun metal piston. The new meter has a rubber piston, giving great lightness, and its proportions have been changed to give greater strength. The latter has been effected by increasing the diameter and decreasing the height, or length, of the piston, which strengthens the latter at the lips, or where the ring of the piston is cut away for the bridge, as shown in the left of Fig. 1. For special service, as for measuring hot water, the new shape will be used, made of metal as before.

The main wear of the meter comes on the cylinder heads and the top and bottom of the piston. The former can be easily tooled down to a plain surface, and the latter can be offset by shortening the cylinder ring, both processes requiring only simple tools and ordinary skill. Of course these processes could not go on indefinitely without using up too much of the material and seriously impairing the accuracy of the meter, but they might be so employed as to greatly increase the life of the meter, especially as under ordinary circumstances the wear would be very small. What is most feared now, it may be added, in the wearing out of meters, is sharp, gritty matter, of some size, rather than finely divided, smooth particles of mud and clay, such as is carried by the Ohio or Mississippi and most rivers of the West and South.

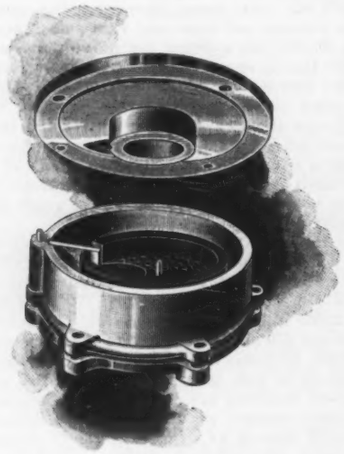


Fig. 1. Cylinder and Piston.

Fig. 2.—Base and Screen.

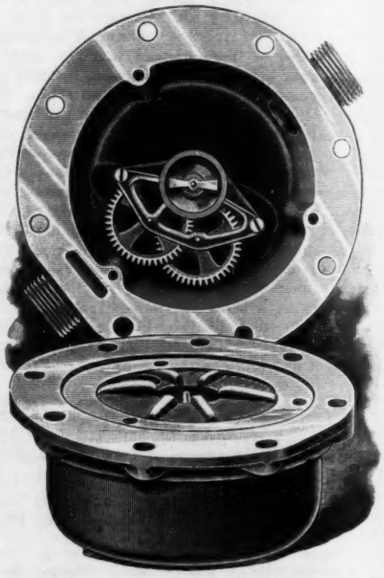


Fig. 3.—Intermediate Gearing and Meter Complete.

THE IMPROVED EMPIRE WATER METER. Made by The National Meter Co., New York City.

A NEW PROCESS FOR THE DIRECT PRODUCTION of iron and steel from the ore is being introduced in Sweden by Dr. De Laval, the well-known inventor of the cream separator and the De Laval steam turbine. According to a description in the "Iron Age" by Mr. Fred. H. Daniels, general superintendent of the Washburn & Moen Mfg. Co., of Worcester, Mass., who has recently returned from Sweden, the process consists in mixing pulverized iron ore with carbon, probably in the form of pulverized peat, and subjecting the same in some form of a rotating cylinder to heat, after which it is brought into direct contact with an electric arc of tremendous power, which reduces the ore to metallic iron. The melted iron then flows into a large and highly heated furnace, where it can either be manufactured directly into steel or cast in any suitable form for further treatment. Dr. De Laval commenced his experiments something like three years ago at Trollhattan. During this period he has been assisted by a competent corps of mechanical engineers and metallurgists, and it is evident these experiments have produced results, from the fact that he has purchased one side of the entire water power at Trollhattan, which is made up of four falls, an aggregate horse-power of from 60,000 to 70,000. He has also purchased at considerable expense very much larger water powers in the north of Sweden. It is interesting in this connection to note that quite a number of the iron and steel works in Sweden have become so interested in the possibilities of this process that they have purchased all of the available water power in their vicinity.

A NEW AND LARGE DEPOSIT OF IRON ORE of the finest Bessemer quality has been discovered at Iron Mountain, Mich., according to a press despatch. It was discovered when the water was turned into the new channel dredge for the Michigamme River, for the purpose of reclaiming the Mansfield mine, which was flooded several years ago, drowning 27 men. Six inches below the sand covering the river bed was found the new bed of ore, which was traced nearly 300 ft. The depth has not yet been tested.

AN OHIO RIVER SURVEY is being made for the U. S. Government by Mr. R. R. Jones, U. S. Assistant Engineer under Major W. H. Heuer, Corps of Engineers, U. S. A. It is officially known as the Marietta-Pittsburg Survey, and covers about 180 miles of the river, and comes under the Act of Congress appropriating $1,100,000 for the construction of locks and dams, Nos. 2, 3, 4 and 5. This survey is to be the most exhaustive ever made of this part of the Ohio River, covering the position of the channel, location of channel eddies, shallows, bars, islands, geological formation of the banks, high and low water marks, velocities and volume of the river and precise leveling. The last authentic survey from Clipper Mills to Cairo, a distance of 696 miles, was made in 1868; the river, from Clipper Mills to Letarte, 37 miles, was last surveyed by C. A. Fuller, in 1844, and the 234 miles, from Letarte to Pittsburg, was last surveyed in 1837, says the Pittsburg "Chronicle." It is evidently time that the whole river was resurveyed, and those most interested expect that Congress will order the continuation of the present survey so as to cover the whole river, from Pittsburg to Cairo, at least.

BRIDGES OVER THE OHIO RIVER, between Pittsburg and Cairo, number 22. The list is given as follows by the Pittsburg "Chronicle" in connection with a protest from rivermen against the manner in which they are built, the height above low-water mark is included: Point bridge, highway, 73.3 ft.; Ohio Connecting railroad, 83.5 ft.; Rochester, under construction; East Liverpool, building; Beaver, highway, 88.9 ft.; Steubenville, highway, 89.6 ft.; Wheeling and Marietta, highway, 91.6 ft.; Wheeling suspension, highway, 91.5 ft.; Wheeling bridge, 96.2 ft.; Bellaire, railroad, 90 ft.; Marietta, building; Parkersburg, 90 ft.; Point Pleasant, railroad, 91.4 ft.; Ceredo, railroad, 98 ft.; Newport and Cincinnati, railroad and highway, 98.1 ft.; Newport and Cincinnati, highway, 102 ft.; Covington and Cincinnati, highway, 105.5 ft.; Chesapeake and Ohio, railroad, 104.4 ft.; Cincinnati Southern, railroad, 105 ft.; Louisville and Jeffersonville, railroad, 92.8 ft.; Ohio Falls, 92.8 ft.; Kentucky and Indiana, railroad, 106.5 ft.; Henderson, 101.3 ft.; Cairo, 105.2 ft. In addition to these charters have been granted for bridges at McKees Rocks, Sewickley, Ironton and several other places. Ten years ago the rivermen succeeded in having a law passed requiring all bridges over the Ohio and below the Kanawha to give a clearance of at least 90 ft. above low-water mark. They now demand a channel span of 800 ft. instead of the 500 to 550 ft. used in the later structures.

THE POTOMAC RIVER RETAINING WALL, at Washington, D. C., is almost completed. This wall, which will be nearly six miles long when finished, was authorized in 1882 as a protection to the land filled in and reclaimed on the Washington and Georgetown side of the Potomac River in the improvement of that river. The reclaimed land is in three sections, aggregates 621.12 acres, and this area is set aside for park purposes. The wall, commenced in 1890, is now 28,172 ft. long, and 2,000 ft. are yet to be built. It is founded upon a riprap base 20 ft. wide at the bottom and 5 ft. at the top and the wall itself is 6 ft. high and about 3½ ft. thick, extending 3 ft. above high tide. The wall is backed with oyster shells or gravel and back of this is the filling material taken from the Washington Channel, deepened under the same act of Congress. A tidal basin is included in one of the filled areas, and this basin is provided with automatic gates admitting water at high tide from the Georgetown channel and emptying it into the Washington channel at low tide.

BLACK AND WHITE ASPHALT ROADWAYS have been proposed by the Public Works Department of New York for the Western Boulevard. The purpose is to separate the truck, or heavy vehicle traffic, from the light traffic, by dividing the 26-ft. roadways on each side of the car tracks into two distinct roadways by the difference in color. This would only be done in case of the passage of an ordinance now before the aldermen compelling trucks to keep to the gutter side of the street and leaving the inner half of each roadway clear for light traffic. An alternate plan proposes a 1-ft. strip of white asphalt as an indicator of the dividing line of traffic. Since writing the above, the ordinance has been passed.

A TREADLE-MOTOR HOSE CARRIAGE is being tried by the Berlin Fire Department. This carriage carries six men; two in front, who attend to the steering, while four men in the rear operate a treadle which communicates motion to the two rear driving-wheels by belts. The body of the vehicle is made of wood and steel tubes and the apparatus is claimed to be generally successful in operation. This standard of excellence, however, is based upon the comparatively slow methods of the German fire department.

October

ENGIN

- AMERICA

ENGINEERING
Notes of a Tr
Street Railway
The McMullen
The Rowan St
Standard Trac
ver & Rio G
Progress in U
and Autom
An Automatic
Railways (Il
Paving Along
Electric Loco
way .....
An Example
Engine (illu
Notes from th
A Graphical
Compression
Iron in New
Direct-Connec
in Germany
Legal Decisio
Book Review
EDITORIAL N
The Preserva
U. S. Geolo
fessional E
ter Ship C
EDITORIAL:
The Street
LETTERS TO
Operating S
—Credit fo
The Weig
ings for F
Long Dist
Neat Pam
and the Is
Pumping
A Schedul
Sewage D
graphic S

THE DES
by Mr. Thor
New York ci
town Creek
joint bridge
men and the
clear span is
leaves 85 ft
passing over
cables being
hoisting pla
was at first
free end of
of the creek
has been wi
roadway, tw
water line.
including th
C. E., Coun
for the brid
have entered
designs, but

THE COL
at Columbi
wind storm
was claime
country. T
1812, at a
away by a
pense of $1
vent the pa
the adjoini
R. Co. bou
railway br
mid-stream
Baltimore
The storm
but left th

THE NE
certificate
and opera
two miles
way, som
the Broo
the City
is only $
Alonzo
Fritz Hil
tun, E. H
ently a
project.

THE
of New
consultin